SCIENCE

VOL. 103 *Friday, February 15, 1946* NO. 2668

Special Nutrition Issue

The Butter-Margarine Controversy

Harry J. Deuel, Jr.

Developing Food Acceptance Research

W. Franklin Dove

James Bryant Conant

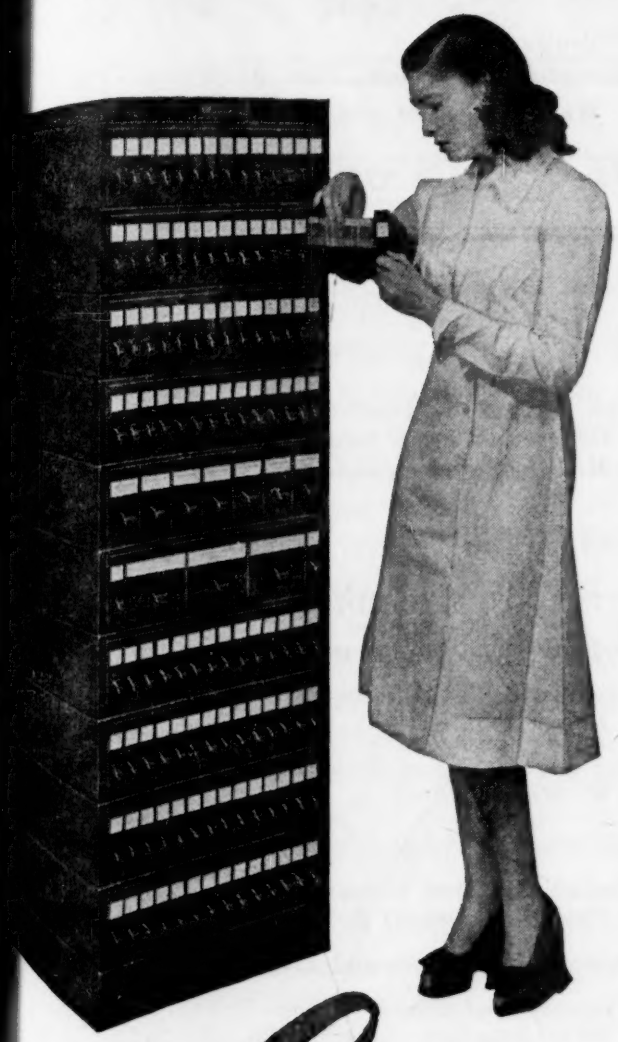
Karl T. Compton

Compromise Bill for a National Science Foundation

Published by the

American Association for the Advancement of Science

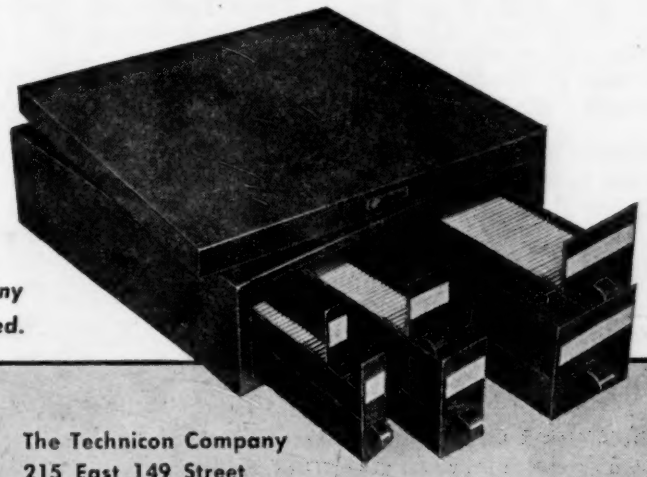
a steel microslide filing cabinet offering



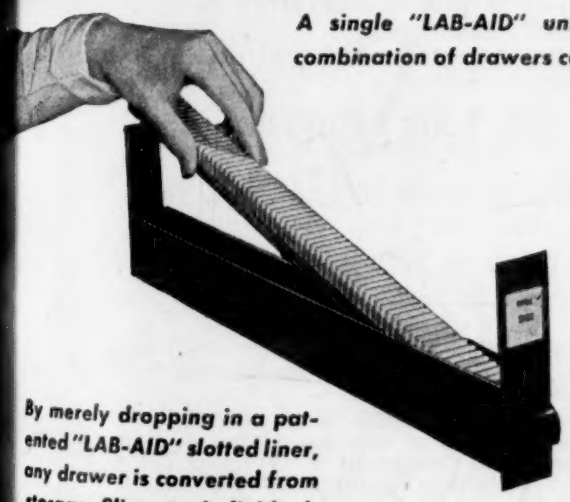
45% greater capacity at amazingly low cost!

This new "LAB-AID" cabinet is the *ultimate* solution to the filing problems encountered in the laboratory. It is of welded-steel, fire-resistant construction throughout. Files 3"x1" or 3"x2" microslides, 2"x2" transparencies, large lantern slides, index cards, even paraffin blocks . . . in single-row drawers, all fitting *interchangeably* into a smooth-tracking master drawer-rail system. Unit-sections, assembled in any combination, can be used singly, or stacked to any convenient height. With all these advantages, the *cost-per-slide* capacity in the "LAB-AID" cabinet is the *lowest ever.* Investigate this remarkable equipment . . . the coupon will bring details.

the new steel Lab-aid laboratory filing cabinet



A single "LAB-AID" unit-section. Any combination of drawers can be supplied.



By merely dropping in a patented "LAB-AID" slotted liner, any drawer is converted from storage filing to individual-slide filing, or vice-versa.

THE **technicon** COMPANY

The Technicon Company
215 East 149 Street
New York 51, N. Y.

Please send me details concerning your "LAB-AID" microslide filing cabinet.

Name_____

_____

Street_____

City_____

SCIENCE

Editor: Willard L. Valentine
Assistant Editor: Mildred Atwood *Advertising Manager:* Theo. J. Christensen
Policy Committee: Malcolm H. Soule, Roger Adams, Walter R. Miles and Kirtley F. Mather

VOL. 103 FRIDAY, FEBRUARY 15, 1946 No. 2668

Contents

SCIENCE: A Weekly Journal, since 1900 the official organ of the American Association for the Advancement of Science. Published by the American Association for the Advancement of Science every Friday at Lancaster, Pennsylvania.

Communications relative to articles offered for publication should be addressed to Editor, Massachusetts and Nebraska Avenues, Washington 16, D. C.

Communications relative to advertising should be addressed to THEO. J. CHRISTENSEN, Massachusetts and Nebraska Avenues, Washington 16, D. C.

Communications relative to membership in the Association and to all matters of business of the Association should be addressed to the Permanent Secretary, A.A.A.S., Smithsonian Institution Building, Washington 25, D. C.

Annual subscription, $6.00 Single copies, 15 cents

Entered as second-class matter July 18, 1923 at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

SCIENCE

Vol. 103, No. 2668 Friday, February 15, 1946

The Butter-Margarine Controversy[1]

Harry J. Deuel, Jr.

School of Medicine, University of Southern California

THE QUESTION WHICH VITALLY INTERESTS all of us is whether we need to feel undue alarm from a health standpoint at the present-day scarcity in butter. In other words, need we be necessarily distressed not only for our adult population but especially for our growing children if the butter shortage continues over a prolonged period?

We have become much more conscious as to what good nutrition involves since the war began. The Food and Nutrition Board of the National Research Council has published a chart of recommended dietary allowances which have been generally accepted as the most authoritative information to date. In their table, they have separated the requirements not only according to age and sex but also according to the extent of activity. In addition, this committee has suggested certain minimal dietary requirements necessary during pregnancy and also during the period of lactation. In the opinion of the Board, there was already adequate experimental evidence to indicate the probable daily requirement of calories, protein, and such inorganic ions as calcium, iron, copper, and iodine. It was also possible to formulate recommendations for the daily quantities of the fat-soluble vitamins, A and D, needed, as well as for two members of the B complex, namely, thiamin (B_1) and riboflavin (B_2 or G). Figures for the amount of vitamin C required were also included. While it was recognized that other inorganic salts and a number of vitamins listed as members of the B complex are also essential in an adequate diet, it was considered that our present information is inadequate to hazard a guess as to the amount required. While it is generally recognized by students of nutrition that, at best, the quantities of nutrients postulated by the Food and Nutrition Board of the National Research Council are tentative, this table has served as a most useful yardstick in the formulation of diets of high quality.

The question of importance in the topic under discussion is whether the fats play a specific role *per se* in this nutritional picture; if they do, one must ascertain whether such a function is reserved for butter and animal fats or whether it is shared generally by the vegetable fats and oils as well. The vegetable oils and fats (including the hydrogenated ones) are practically identical in physical and chemical properties with the animal ones. Can the body cells reject one and require the other?

Fats are the best vehicles for dissolving the fat-soluble vitamins, A, D, E, and K. From that standpoint, one might regard the fats as an essential foodstuff since they afford a simple medium to assure the absorption of these required vitamins.

Fat is also the most concentrated form of energy. To obtain the energy to produce the 2,500 calories which the person of average stature expends daily, it is necessary to oxidize ingested foods or, in their absence, body tissue. As large a proportion as 85 to 90 per cent of this total energy may originate from the metabolism of either carbohydrate or fat (or, as is generally the case, of a mixture of these foodstuffs). The quantity of fat to supply all the necessary heat would be 240 grams, since fat has an energy value of 9.3 calories per gram; were carbohydrate to serve as the sole source of this 90 per cent of the daily caloric requirement, about 550 grams would be used, as this foodstuff has a heat value of only 4.1 calories per gram. Moreover, since carbohydrate is usually present in foods along with considerable quantities of water while the fatty foods may be largely free from water, the discrepancies between the weight of food required to satisfy the caloric needs of the animal far exceed the 2.3 to 1 ratio of the caloric values of fat to carbohydrate.

It is believed that certain types of fats which are normally components of such structural parts as cell membranes cannot be manufactured in the animal body. The only source for this material, which appears to be an unsaturated fat, trilinolein, is in the food. Fats must be considered essential to the extent that they are necessary to furnish an adequate amount

[1] A lecture given before the Men's Faculty Club of the University of Southern California on 23 May 1945.

of this constituent. Corn oil is especially rich in trilinolein while butter may be largely devoid of it. We, of course, manufacture the usual type of adipose tissue without the necessity of the fat being supplied in the diet. An excess of fatty tissue is generally a reflection of a fondness for carbohydrates, since we can readily transform the latter foodstuff into fat.

An examination of the dietary habits of animals gives us definite evidence that milk fat is not required after infancy. Wild animals have continued a normal existence over centuries without milk or butterfat after weaning. Except for the cat, dog, and pig, the same is also true for domestic animals. As far as the human is concerned, the widespread use of butter and milk in the diet of the adult, made possible by the domestication of the cow, goat, horse, or camel, has come late in the history of the human race. Man has attained his physical and mental stature largely without milk fat after weaning. In fact, within our present era, certain Indian tribes have been known to live satisfactorily after the nursing period on diets which are completely devoid of milk or butterfat.

We come back now to the question as to how effectively oleomargarine can do the job of butter. The term "oleomargarine" dates back to the time when oleostearine and oleo oil, by-products of the meat packing industry, were its principal ingredient. But still legally any margarine, regardless of the nature of the fat it contains, must be labeled "oleomargarine."

In the beginning, the margarines were maligned as inferior fats which were indigestible. However, investigators in the Office of Home Economics of the U. S. Department of Agriculture for some time previous to and during World War I had been comparing on human subjects the digestibility of various well-known animal and vegetable fats as well as many which were so unusual from a commercial standpoint that they were curiosities. With a very few exceptions, the coefficient of digestibility was invariably found to be approximately 95. This means simply that 95 of every 100 grams are absorbed from the gastrointestinal tract during the course of digestion and are therefore utilizable. In this group were all the common cooking oils as cottonseed, corn, peanut, and olive oils as well as butter and lard. The only exceptions to this relatively complete digestibility were noted with beef and mutton tallow and deer fat as well as several other natural or artificial fats having a melting point considerably higher than body temperature. Studies on several different oleomargarines by these same government scientists demonstrated equally high digestibilities for the oleomargarines as for butter. It is an interesting commentary that although these experiments were completed in 1917, the publication of the results was not made in one of the series of scientific government bulletins where the reports of the tests on the other fats had been published but in the *Boston Medical and Surgical Journal* in 1925 after the principal author had severed his connection with the government bureau. Today, no one questions the high digestibility of margarine.

Another earlier objection, political rather than nutritional, brought up against margarine was that it was made from foreign fats which were brought in to compete with the products of American farms. This may have been partially true when coconut oil was the basic fat used in margarine production; certainly, it can no longer be raised as an objection now that cottonseed, peanut, and soybean oils or animal fats which are almost entirely domestic products are practically exclusively used for the present-day margarine manufacture.

A third argument for the superiority of butter over margarine was advanced in 1913, when it was found that the former was a good source of vitamin A. Since it was soon determined that this vitamin, so essential for growth and for life, was absent in most vegetable oils, there would then appear to be some justification for the preference of butter to margarine on nutritional grounds. However, as soon as colorless vitamin A concentrates were available (there was a law against use of yellow-colored oils even when they contained the same natural provitamin A as butter, *i.e.* β-carotene), it became the practice to add sufficient of the vitamin A concentrate to margarine so that the concentration of vitamin A would be equal to that of an average butter. The amount of vitamin A to be used for the enrichment of margarine was originally set at 7,500 U.S.P. units per pound but later raised to 9,000 U.S.P. per pound, which was considered the average quantity in butter, although different butters may vary from 2,500 to 20,000 units per pound. Unfortunately, there is no way for the housewife by inspection of its label or of the butter itself to ascertain how much vitamin A is present. Although high concentrations of vitamin A usually run parallel to increasing yellow color in the natural product, this is not always the case. In fact, butter samples having the highest concentrations of vitamin A ever reported, produced by feeding massive doses of this vitamin to the cow, were found by the author to be practically colorless. But even if the depth of color were invariably a satisfactory index of the richness of butter in vitamin A, this criterion would be valueless as far as market butter is concerned. Artificial colors, which have no nutritive value whatsoever, are usually added to bring

the product to the desired hue. Butter is the only food exempt from the requirement of the pure food laws which makes mandatory the declaration of artificial color on the label of foods. No statement is required on the label or elsewhere that an artificial color has been added.

However, several years ago reports were published in the *Journal of Dairy Science* of work carried on in the University of Wisconsin indicating that butter *per se* possesses a certain growth-promoting influence (independent of the vitamin A effect) which could not be demonstrated in various vegetable oils. Weanling rats when given diets of whole milk grew faster during the first three weeks than other rats which received skimmed milk into which vegetable fats were homogenized. The differences were largely eliminated by the end of the six-week period. It was suggested that this effect of butter was to be ascribed to certain long chain saturated fatty acids present in the butterfat which were not contained in the vegetable oils. This was taken as the long-awaited "proof" that butter possesses some inherent characteristic not shared by vegetable fats which make its use in animal nutrition preferable. Although these preliminary experiments were not convincing from a scientific standpoint, the results were heralded far and wide by the dairy interests. It was not long before many of our intelligent citizens were wondering if butter should not be a "must" in the diet.

Extensive experiments were undertaken several years ago under the direction of the author at the University of Southern California to amplify the studies started at the Madison laboratories. These experiments were planned to avoid several criticisms of the earlier work which obviously would favor the butter animals. In the first place, the weanling rats were so distributed into the groups receiving the various diets that the average weights were identical in the various groups at the start. In the Wisconsin tests, the rats which were given the butter diet weighed 31 per cent more at the start of the experiment than those which were fed the cottonseed and soybean diets. Since the weight at weaning is a good index of the subsequent rate of growth, such low-weight groups could hardly have been expected to have grown as well even if afforded a superior diet to the butter rats. A second difficulty of the Wisconsin group was avoided by using dried skimmed milk powder mixed with the various fats instead of the liquid skimmed milk. In this way the diet remained homogeneous and a separation of fat from the liquid milk did not occur. The results of our tests showed that corn, cottonseed, olive, peanut, and soybean oils as well as a commercial margarine were all equally efficacious in promoting growth, as was butterfat on diets of mineralized skimmed milk powder which were fortified with the fat-soluble vitamins. No differences in rate of growth were noted after 3, 6, and 12 weeks. That the growth was similar for the rats on the different diets was further confirmed by the finding that the growth of their bones (tibia) at 3 and 6 weeks measured by X-ray photographs was identical. The diets were all shown to be equally well utilized, as demonstrated by the fact that the same amounts were required to cause equivalent growth. Moreover, the composition of the body tissues of rats sacrificed after receiving the different diets for 12 weeks was also shown to be similar. This would indicate that all fats were equally efficient in producing real growth and that the gain in weight in no case was only the result of an undue deposition of fat.

The Southern California experiments reported above also demonstrated the important part flavor may play in the diet. It was found that when rats were given a choice, they would usually prefer the butter-containing diet to the one having the vegetable oil. It was found that this preference is related to the so-called "butter flavor" normally present in butter, and it can as readily be induced by pure diacetyl or by commercial butter flavor as by butter itself. The quantities necessary to induce this preference are very small, only 4 parts per million being required. In fact, rats prefer a level of 4 to 8 parts per million and 8 to 16 parts per million. Possibly some of the better growth reported earlier on rats receiving butter may be because the animals are induced to eat more of such food. The flavor is a pleasing one which they have learned to prefer during the period of nursing. As far as can be determined, however, diacetyl plays no essential role in nutrition, and it can be manufactured by the normal male as well as by the lactating female.

In further experiments it was reported that the vegetable oils were equally satisfactory components of the diet as butter in furnishing adequate nutrition for normal pregnancy and for lactation. The index as to the efficiency of lactation can be deduced from the proportion of baby rats which survive as well as by the weight of the rats when they are weaned at the age of 21 days. In a large number of tests on the various vegetable fats, margarine, and butter, there was no evidence of superiority in any dietary group. In fact, in all cases the diets were equally effective in allowing normal pregnancy and successful lactation.

Recently some additional evidence has been adduced on the claim of the Wisconsin investigators that butterfat is especially required by the very young rats. They stated that prematurely weaned rats required butterfat to a greater extent than animals weaned at the normal time. Moreover, if animals were weaned

at a later than normal period, no superiority in the butter diet could be noted. However, Zialciti and Mitchell, of the University of Illinois, were able to raise successfully rats fed on artificial mixtures by the use of medicine droppers starting within seven days after birth. When such animals were given mixtures containing corn oil, the subsequent growth was as satisfactory as for those which were fed on a mixture containing butter as the fat. We have reported similar results on a large series of rats weaned at 14 days instead of the usual 21-day period which received diets containing a butter or margarine or corn, cottonseed, peanut, or soybean oils.

More recently, the Wisconsin scientists have stated that growth of young rats was as satisfactory when oleomargarines were incorporated in the diets as when butter was the fat, provided that the basal carbohydrate in the diet was starch, dextrin, sucrose, glucose, or mixtures of them. Only when lactose was the sole carbohydrate was there some indication of less satisfactory growth on the nonbutter tests. It should be mentioned that the lactose content in these tests was higher than in whole milk powder. When lactose is present in the proportion found in whole milk, the weight of evidence is that all vegetable fats have a nutritive value similar to butter if fortified with the fat-soluble vitamins.

Another crucial test for the adequacy of a diet is its ability to support growth and reproduction over a number of generations. Dr. H. C. Sherman, of Columbia University, has maintained a colony of rats for 50 generations on a diet consisting of one-third whole milk powder, two-thirds whole ground wheat, and a little salt supplemented with small amounts of lettuce and lean meat once a week. Such a diet must therefore be considered as entirely adequate for the rat. In the May 1945 issue of the *Journal of Nutrition,* there is a progress report of the author detailing experiments where rats had already been maintained over ten generations on a diet identical with Sherman's except that skimmed milk powder was used in place of the whole milk powder and an amount of margarine fat was added corresponding to the normal content of butterfat in the whole milk powder. These tenth-generation animals were in much better physical condition than the first-generation rats. In fact, at the present time the experiment has progressed to the thirteenth generation and the rats have continued to be in excellent condition.

It is a moot question how far tests on rats can be applied to humans. Certainly many of the dietary deficiency diseases found in the human subject have their counterpart in the rat. The rat, like the human, is omnivorous. The anatomy of the gastrointestinal tract is similar. To accomplish a study over ten generations in the human would require 300 years compared with five years in the rat. From the analogies between rat and man, it is not too much to expect that a diet which is nutritionally satisfactory for the rat would also be beneficial for man and vice versa. Conclusions on the nutritional value of diets for humans based on rat experiments would seem to be entirely justified as far as fats are concerned.

Even had it been shown that milk fat were a requirement for animals or for man, one would expect that the milk fat from any one species of animal would meet the requirements best for that particular species. It is well known that there is a wide difference in the composition of the milk of different species and also that this variability in composition also obtains with the fat. Hilditch and Meara in the conclusion of a paper where the composition of fat from human and cow's milk has been compared state the following:

> Human milk fat, in regard to its component acids, has more resemblance to a typical margarine fat-blend than to butterfat.

The experiments that I have just outlined reaffirm that fact that vitamin-fortified margarine and butter have a substantially equivalent nutritional value. They are supported by the conclusions of an entirely unprejudiced group, the Committee on Public Health Relations of the New York Academy of Medicine, who recommend in their report of 1 February 1943 as follows:

> In order that the health of the population may not be impaired by the adoption of a diet insufficient in fats and fat soluble vitamins, the Committee recommends that the manufacture, distribution, and consumption of oleomargarine be encouraged and suggest specifically:
>
> (1) That the regulations set by the Federal Security Administrator in 1941 be amended to make it mandatory that all oleomargarines be fortified with vitamin A at a uniform level of 9,000 United States Pharmacopoeia Units per pound of finished product;
>
> (2) That the War Production Board be requested to allow the use of fats and oils for the manufacture of oleomargarine in such quantities as would offset the necessary withdrawal of butter from civilian use;
>
> (3) That federal and state laws which restrict the manufacture and distribution of oleomargarine be suspended for the duration of the butter crisis;
>
> (4) That wide publicity, both lay and professional, be given the fact that oleomargarine, fortified by vitamin A, is nutritionally equal to butter; and
>
> (5) That this matter be brought to the attention of the President of the United States, the Secretary of Agriculture of the United States and his Technical Assistant on Civilian Requirements, and the Commissioner of Agriculture and Markets of New York State.

Moreover, a similar conclusion has been reached by

the Food and Nutrition Board of the National Research Council in their Reprint and Circular Series, No. 118, released in August 1943, where it is stated:

(1) Margarine fortified with vitamin A in accordance with Food and Drug regulations supplies an important amount of this nutrient as well as of much needed fat. A previous recommendation of the Food and Nutrition Board that all margarine be fortified is reaffirmed. Because of the high proportion of margarine now fortified, mandatory requirement of fortification for all margarine for table use seems unnecessary at present, though it may become desirable if the situation changes in such a manner as to reduce importantly the proportion now fortified.

(2) The present available scientific evidence indicates that when fortified margarine is used in place of butter as a source of fat in a mixed diet, no nutritional differences can be observed. Although important differences can be demonstrated between different fats in special experimental diets, these differences are unimportant when a customary mixed diet is used. The above statement can only be made in respect to fortified margarine and it should be emphasized that all margarine should be fortified.

(3) It is obvious that the present excise and license taxes imposed by both Federal and State governments on margarine interfere with the distribution and utilization of certain of our fat resources, but the implications of these taxes are so extensive and complex that no recommendation with respect to them can be made in this report.

Finally, it should be stated that the nutritional value of milk is not confined to the fat; it possesses proteins of excellent quality and it is an excellent source of certain inorganic salts needed in the diet, such as calcium and phosphorus. Milk is an especially adequate source of riboflavin. We can scarcely view with concern the increasing use of margarine in the diet if that means that larger amounts of whole milk become available at a reasonable cost for human consumption.

Developing Food Acceptance Research[1]

W. Franklin Dove, *Chief*

Food Acceptance Research Branch, Subsistence Research and Development Laboratory, Quartermaster Depot, Chicago

At the present time there appears to be in process of development a science which treats of foods and the consumer of foods as a *relationship* in which the producer or processor of foods (for industrial survival) and the consumer of foods (for human survival) share an equal interest.

During World War II, now just ended, each item of the ration had been carefully produced and prepared according to quality specifications, and each item had been tested to contain and retain through long periods of storage its quota of vitamins, minerals, protein, and calories. But when the soldier-consumer refused to accept some of these ration items, and when these items began to accumulate in the storage dumps in various theaters of the war, a new problem in supply, theretofore unrecognized, was raised to a major issue. To determine the causes of nonacceptance followed as an official directive.

Parallel with the refusals by the soldier-consumer, populations under economic stress, or belabored with a poor soil, or lost in the forest fringe or in marginal environments, or seduced into overspecialization, reveal similar conflicts over acceptance and nonacceptance of foods.

The reasons for this parallel will appear with further development of the subject. Needless to say, both the Army population under stress and the civilian population isolated from the normal balance of supplies—even though it may be living in the midst of a prosperous society—have much in common.

But why had not the subject of food acceptance become an issue before? In order to answer this question and in order to uncover causes, as a step toward instituting prevention, let us go back a few decades.

Not long ago, even in the time of our grandfathers, there was little need for concern over the nonacceptability of the harvest. Each family was largely self-sufficient. Out of the family garden the *seed* for the coming year—and only the best—was selected. That *best* of the harvest was judged at the family table by means of a sizable panel of children and parents, aunts and grandparents, a panel representing all ages and both sexes.

Locally adaptable varieties of sweet corn, apples, squash, peas, beans, bred on the spot for acceptability, were also prepared and cooked in home style. Home cooking meant recipes devised out of the ingredients at hand, upon which the family panel had also placed its stamp of approval. These home recipes had sometimes passed through the judgment of generations of

[1] Research in food acceptance was formally introduced into the Army's food supply program when, in November 1944, a Food Acceptance Research Branch was set up in the Subsistence Research and Development Laboratory, under Col. Rohland A. Isker, Commanding Officer. Food acceptance research has since been included as a section of the food research program of the Military Planning Division, OQMG. This paper was presented at the Conference on Food Acceptance Research held on 6–7 December 1945 in Chicago, under the sponsorship of the Committee on Food Research, Military Planning Division, OQMG.

families: As the seeds from the best-flavored or the finest-textured foods were saved, so too were the favored methods of preparation and cooking passed down from mother to daughter or from mother to daughter-in-law.

Accordingly, then, the family taste panel passed judgments three times daily, from a breakfast *for work* to a supper *after work,* every day of the week from Monday's labors to Sunday's rest and throughout the seasons, from rain to heat to snow. Though subject to the influences of *imitation,* as when a child imitates one of his parents in food choice; of *domination,* as when a parent punishes a child by depriving him of dessert; of *urging,* as when a mother who, in concern for the well-being of the sickly child, urges him to drink milk; or of *resistance,* as a form of a child's self-assertion in refusing any or all foods presented, nevertheless, the vocal judgments of the family taste panel varied from unanimous vote against the food to unanimous acclaim for the food. The family taste panel passed judgment upon many characteristics conceded important in today's scientific panels: (1) odor, appearance, flavor, texture, and temperature; (2) frequency, monotony, or amount served; (3) the variety grown and even, indirectly, the nature and fertility of the garden soil; (4) methods and temperature of storage as these conditions affected keeping quality; and (5) keeping quality of the raw food, or as cooked (processed) and sealed within the jug, barrel, or jar. All of these judgments, combined into a family chorus, came to expression in the food habits of the consumers and came finally to shape the pattern of the agriculture of every region.

During these earlier times in our history, there were segments of the population isolated from the soil and consequently subjected to limited diets; but for none of these did concern over taste, flavor, and acceptability rise to the level of social, economic, or scientific importance until recent times.

We may conjecture that this gradual rise to awareness of the problem of food acceptability is the result of the gradual change, taking place during the past century, toward *commercial* agriculture with *quantity production* as the chief goal, together with the widespread production by the great food industries of processed and canned foods for the market, while the original strings of taste authority of the family, as producer and processor and consumer, were severed one by one.

By slow but certain strokes the family's seed stock was replaced by the nursery seed stock, by the stock of the large commercial seed house, by the stock of the State and Federal government experimental seed plots —seed stocks which were developed for resistance to diseases and for high yields. By the same slowly changing pattern of life the family's home-canned foods have been displaced by the standardized, colorfully-labeled, commercial product. The advantages to these changes are greater than appear on the surface.

While the civilian consumer's food-getting habits have changed, so too have the methods of feeding armies. Mechanized warfare of World War II required combat and assault rations which possessed operational characteristics for ease of handling, compactness, and keeping qualities, together with nutritional adequacy and acceptability. Such requirements increased the need for *quantity* production and for *commercially* processed, dehydrated, cooked and canned foods in order to keep up with the rapid surge of huge armies. Such armies, as in the Normandy campaign, must travel fast; or, as in the Pacific Island theater, they may be separated for weeks, or even months, from the normal supplies of fresh perishable foods. For the first time in history large groups of men lived for long periods of time solely on commercially produced and processed foods.

Limited and imposed diets, consumed often under stress, tested severely the nutritional adequacy of rations and, even more, their acceptability. For no matter how adequate these foods and rations were nutritionally, only in so far as they were accepted were they a dependable conveyor of nutriment to the body.

With acceptability of foods in this salient position, and with our continued interest in mass feeding, the need has arisen for a careful screening of all scientific researches and methods which might contribute to the evaluation of foods for acceptability. Neither the food producer nor the food processor nor the food consumer (soldier or civilian) can afford to allow food acceptability to remain in its past-present unorganized form. All indications lead one to believe that postwar developments in foods and in feeding, as well as in other approaches to the biological aspects of man's adjustment to his environment, will make extensive use of the scientific advances that may be made in these directions.

The science of genetics has taken the guesswork out of seed selection for disease resistance; food technology and experimental cookery have taken the guesswork out of food processing and food preparation; the science of nutrition has taken the guesswork out of the "plus" factors in foods; while physiology has devised accurate measures of physical and nutritional status of the consumer. But by this modern, efficient, centralized production and processing of foods on the one hand, and by the recognition and supply of the major and minor nutrients required for abundant health on the other, we have left out the relationship— we have left out the *connecting link* between the living

subject (the consumer) and the stuff of life (food) he lives upon: *that link is acceptability.*

Now is the time for the *essence* of the family taste panel, now lost, to be returned—not as it was, but in a modern scientific form, to follow the food from its seed, through development and processing, to the finished, or even assimilated, product. Such a science, if properly developed, is destined to contribute to both consumer and producer alike.

Who will develop the science of food acceptance? Since food acceptance, as someone has aptly remarked, is an in-between study, its proper development will depend upon the combined interest of numerous special approaches. It should include:

(1) Those who have attempted to grade foods for *quality* for government or army specifications, since an application of the blind panel of judges selected on proven ability to test the food or item according to a reliable statistical design provides unbiased decisions and scientific quality control;

(2) Those interested in psychometrics in order to standardize the quality-control methods used for liquors, tea, and coffee, and apply them to milk, eggs, beverages, and finally to all classes and kinds of foods;

(3) Those in food technology and home economics who have used organoleptic methods to determine chemical or physical changes in foods treated or stored in numerous ways;

(4) The biological sciences concerned with self-regulation, or with the embryology, anatomy, or physiology of the sensitivities related to food-getting and to appetite and hunger;

(5) Those interested in social psychology and anthropology, to indicate the background of forces in which food-getting has been reared.

There is need for economists who are aware of the physiological demand as well as market demand; nutritionists who consider food *selection* from the psychological standpoint; and psychologists who know that *food* selection is a matter of nutritional importance.

The question will also continue to tantalize the chemist, who will always try—and may some day succeed—in detecting differences and tracing dilutions with an accuracy equal to that of all the gustatory sensitivities.

Finally, it should interest those who are administrators of research, since food acceptance techniques provide *direction* from the consumer. In other words, food acceptance tests are on more than a mere service-level, since in addition to this they may be used not only *to develop* a product from a correct combination of parts, but also to indicate *what foods to develop* and *in what direction.* As such, they serve the administrator and should therefore be free of any compartmentalization which would disturb their functional nature.

In order, then, to develop the subject of food acceptance as a unit of research, we of the Food Acceptance Research Branch of the Subsistence Laboratory have included in the physical plant the facilities for as many of these approaches as seemed feasible and have relied on various research laboratories of the country, both university and industrial, to carry on correlated research where the best talent, ability, and equipment exist.

Thus, the Food Acceptance Research Laboratory includes in actual concrete structure the facilities for a large number of the potential functions of such research: the statistics of sampling, of design, and of results; the physiology of sensitivities and the psychology of attitudes; the physicochemical tests of quality of the foods; experimental cookery as related to preference; psychometrics and organoleptics. Each of the divisions of interest may be likened to a part of a car: Organoleptics or psychometrics may be the wheels, consumer likes and dislikes (physiological psychology or anthropology), the car body; while experimental cookery may be likened to the snubbers and upholstery. No single part can assume the prerogative of the whole.

During the last six months 215 tests for acceptability have been run on 708 items of foods. The foods tested include every food class, from soup to meats, potatoes, cereals, fruits, beverages, vegetables, desserts, confections, and nuts. Entire rations have also been tested. All of the items intended for rations are now tested for acceptability *before* they enter the rations. The same techniques are used to determine by taste test panels the best methods, from the standpoint of acceptability, for packaging and storing, and the optimum keeping time or shelf-life.

New research methods have had to be devised for nearly every food class or type of food. Each food presented for test presents a special problem which must be analyzed through careful discussion with commodity specialists and with others interested in the development of the food.

The results of the tests are presented as memoranda for administrative action, for further development, or for use by the procurement officers to serve as one of their guides in purchasing supplies. The purchase of the winter's supply of breakfast cereal, for instance, may be influenced by the panel judgments as to brand, composition, method of toasting, etc.

The results of these tests are also being prepared for publication as research papers, since methodology is at present at the crux of testing: Without reliable methods the tester and his results are at the mercy

of personal opinion. Several points which characterize these new methods include the following:

(1) A panel of judges is selected for ability to detect the differences expected to arise.

(2) The test is blind, without comparison of notes by the judges.

(3) A record of differences is secured, together with word records to express the differences.

(4) A record is kept of both positive and negative attitudes toward the differences.

(5) There is a statistical design in the experiment set up in order to measure all variables separately and together and establish significance of results.

When the tests are carried out according to these and other precautions, the results may then be considered reliable. Further tests in camps or in the field must be made to evaluate the relative preference for these foods by the group as a whole. The results show, however, that many totally unacceptable foods can now be eliminated before they enter the ration; that many foods are preferred only by *part* of the population and must therefore be accompanied by substitutes; that some items are so well liked and, fortunately, so stable in the storage method indicated that procurement can proceed with confidence. For example, the best variety of peas as tested by the blind panel turned out to be the variety requested most on the grocery store shelf. Such results indicate actual use-value of the methods.

As we have previously indicated, however, our laboratory approach is not sufficient in itself. Preference for, or prejudice against, a food is a population problem. Attitudes toward foods relate particularly to food habits built up over the years from birth to maturity. Furthermore, food habits are related to the soil, the climate, the food crops, and the socio-economic and even religious characteristics of each region. The final effect of food habits upon the civilian and soldier-consumer from each region should be measurable in terms of physical stamina and success in adjustment in times of stress.

The acceptance rates of foods is a part of the general topic of food habits which has been studied in this laboratory. The Committee on Food Composition of the National Research Council has compiled tables on the nutritive value of American foods. The nutritionist, however, needs additional information in order to devise rations or to evaluate foods correctly. The nutritional value of each food is measured not alone by its nutrient content per 100 grams, but rather by the nutrients in the total amount of each food accepted and, of that, the amount assimilated and utilized. The issue is direct; the arithmetic simple. *Each food must be evaluated not by what it possesses but by what it gives to the consumer*; and it gives to the consumer in gross value its per cent value per unit weight times the weight of food accepted. Acceptance rate in turn depends upon a chain of events and influences, any one of which may negate the chemically high nutrient quality of any food. Thus, acceptance rate waits upon the degree of preference, depends upon form and method of preparation, is hindered or facilitated by differences in flavor of the different genetic varieties, and is influenced by its physiological effect upon, and assimilation by, the individual. In the end, food habits, through acceptance rates, mold the physical status of the consumer, soldier and civilian.

Edgar T. Wherry points out in this issue of Science (page 206) that there really cannot be a Soviet science because science is wholly without national identification. It is interesting to note that every nationality does have its own concept of its importance in the development of science and technology. The following extract is taken from *VOKS Bulletin,* a publication of USSR Society for Cultural Relations with Foreign Countries:

For two centuries Russian scholars, inventors, engineers, and talented, self-taught scientists created the bases for modern electrification. Their work, which was of world-wide importance, is one of the greatest prides of our people.

As far back as 1752 lightning rods were invented by M. V. Lomonosov, the father of Russian science.

The searchlight is the child of Russia twice over: the light of its voltaic arc was the discovery of V. V. Petrov, the first Russian electrical engineer (1802), while the construction and focussing of its optics was the work of the electrical engineer V. N. Chikolev (1890).

The first electric mine was invented during the Crimean War by B. S. Jacoby, member of the Russian Academy of Sciences (1854).

The electric lamp is fruit of the work of A. N. Lodygin (1874).

The explosion-proof electric lamp was invented by the Russian electrical engineer V. N. Chikolev (1880).

The transformer was the invention of I. F. Usagin (1882).

The generator was improved by P. N. Yablochkov, A. I. Poleshko and others; the electric motor was invented by M. O. Dolivo-Dobrovolsky (1890). The electric welding instrument was the invention of N. G. Slavyanov (1885).

The radio and radio broadcasting are the inspired invention of the Russian scientists and electrical engineers A. S. Popov (1895) and M. A. Bonch-Bruevich (1920).

Association Affairs

James Bryant Conant

Karl T. Compton, *President*
Massachusetts Institute of Technology

WHEN JAMES BRYANT CONANT accepted the presidency of Harvard University in 1933, at the age of forty, he made the decision to forego the further satisfactions of his brilliantly productive career as Sheldon Emery professor of organic chemistry and chairman of the Department of Chemistry and to shoulder the more complex responsibilities as educational leader of this, the oldest and greatest of our nation's universities. How great and complex these responsibilities were to be he could not then have foreseen, for the next dozen years brought World War II and found him by sheer force of merit and ability in the top key positions of scientific leadership in this struggle. Now, with victory but a few months past, he leads his institution out of its great war program into a well-studied new program of education, and he becomes president of the American Association for the Advancement of Science.

In his own work as a chemist, Dr. Conant has made many contributions of permanent value in two important fields: structural studies of complex natural products, and investigations of basic theoretical significance in the borderland joining organic and physical chemistry. In the latter class is his work on the dissociation of organic molecules into free radicals and quantitative rate and equilibrium studies on organic reactions, including replacements, dissociation of acids, and enolization. Studies of the properties of hemoglobin and the structure of chlorophyll were his major contributions in one of the most complex portions of the field of natural products. An example of Dr. Conant's dual interests in research and teaching is the fact that at the peak of his productivity as an investigator he found time to write the book which has become the most widely used text of organic chemistry.

In recognition of Dr. Conant's achievements in chemistry he was awarded the Chandler and Nichols medals in 1932, the medal of the American Institute of Chemists in 1934, and the Priestley medal of the American Chemical Society in 1944.

Dr. Conant's initial war service was as a Lieutenant in the Sanitary Corps of the U. S. Army in 1917, and in the following year he became a Major in the Chemical Warfare Service. He was one of that small group of outstanding young American chemists who so quickly developed American competence in the production and use of poison gas, and protection against it, immediately after this frightful new weapon had been launched by the Germans against the allied forces in France.

Because of this experience and his subsequent eminent career as a chemist, it was therefore natural that he should have been appointed by President Roosevelt as the chemical member of the National Defense Research Committee when this agency was established as a national defense measure in June 1940 under the chairmanship of Dr. Vannevar Bush. When the President, in 1941, expanded this scientific preparedness program by the establishment of the Office of Scientific Research and Development under the directorship of Dr. Bush, it was equally natural that Dr. Conant should become the chairman of NDRC and thus take the major responsibility for the organization of the nation's civilian scientific effort in the development of new weapons. To this work he brought not only his knowledge of science and acquaintance with scientists, but also great skill in administration and an unusual ability to avoid confusion and entanglement in minor complexities, and to cut through quickly and decisively to the fundamental issues involved.

Then, in the following year, there was another call to service when our supplies of natural rubber were cut off by the Japanese invasion of the East Indies, and the nation was faced with a near impasse of conflicting councils for averting the complete paralysis which would result from rubber bankruptcy. In the Summer of 1942 the President appointed Dr. Conant as the chemistry member of the Baruch Rubber Survey Committee which, after a hectic two months study, submitted to the President the recommendations followed so successfully in establishing a great program of synthetic rubber production and conservation of our remaining natural rubber resources.

Then, in 1943, came the most difficult and important assignment of all as member of the small committee which was appointed to steer the atomic bomb project from the preliminary stage, in which the first laboratory demonstration was made of the feasibility of a nuclear chain reaction, to the final climax on 6 August 1945, when the first atomic bomb was dropped on

Hiroshima. During these last two years of the war Dr. Conant spent an increasingly major portion of his time on the atomic bomb project, unbeknown to any except a few of his closest colleagues, but in spite of this added burden continued effectively to coordinate and steer the program of NDRC.

Any one of the above war assignments would have been a notable contribution to the nation. Taken all together they constitute a truly remarkable record of achievement, and one which can be fully appreciated only by those who have themselves known at first hand something of the magnitude and complexity of the problems which were involved, as well as the success of the achievements and the importance of their contributions to the winning of the war.

Some of these responsibilities continue but, happily on a much-diminished scale, and Dr. Conant is now able to devote increasing time to the reconversion problems and to the establishment of the revised educational program at Harvard University, based on the report of the Harvard committee on General Education in a Free Society.

This record of achievement is ample explanation of Dr. Conant's election to the presidency of the American Association for the Advancement of Science. With the confidence and the teamwork which were developed among American scientists during the war there is a very great opportunity for the advancement of science and its effective contributions to our society in the era of peace which we now enter.

Science Legislation

Compromise Bill for a National Science Foundation

Howard A. Meyerhoff
Executive Secretary, AAAS, Washington, D.C.

Agreement has been reached on the final draft of a National Science Foundation bill which will make its way to the Senate floor as rapidly as legislative machinery can function.

Senator Saltonstall presided at the meeting 9 February, held in the Military Affairs committee room at the Capitol, which accomplished a resolution of conflicting views and redrafted a National Science Foundation bill. Senators Kilgore and Magnuson, representatives of the Committee Supporting the Bush Report, the Committee for a National Science Foundation, and the American Association for the Advancement of Science, with legal counsel, discussed the few remaining provisions of S. 1720 still in dispute. Complete accord was effected on every issue under Senator Saltonstall's leadership.

The new bill,[1] which will now go to the Senate, will be known as the Kilgore-Magnuson Bill. Senators Johnson, Pepper, Fulbright and Saltonstall, and possibly others, will be co-sponsors. The new draft will bear a new number, although S. 1720, introduced 19 December 1945, served as its base (*Science*, 1946, **103**, 39–44).

The changes are not many in number and some of them can scarcely be called improvements; but they have served the purpose of providing safeguards liberalizing, qualifying, or clarifying clauses in S. 1720 to which objections had been raised. The relationship between the Administrator and the National Science Board have been more precisely delineated, reducing the possibility of friction and deadlock. The functions of the Division of Social Sciences are yet partially restricted until the divisional committee surveys the field and submits its recommendations to the Board. Somewhat more rigid standards are placed upon all projects for which Foundation support is sought, and the Adminstrator is given more latitude in denying subvention to proposals that do not conform to the policies and standards of the Foundation.

The patent provisions of S. 1720 have undergone extensive revision without sacrificing the basic principles of free dissemination and public use of all knowledge and discoveries arising from Federal support. The attempt has been made to provide equal access to Foundation support or contracts without requiring or inviting changes in corporate structure of the applicant bodies. At the same time government agencies are no more restricted than they have been in arranging to have essential research done. The new bill provides for the absorption of the Office of Scientific Research and Development and of the Roster of Scientific and Specialized Personnel. The new bill provides a new horizon for international cooperation.

It is a document which combines sound scientific thinking with sagacious political realism and to which scientists can unhesitatingly lend their support.

[1] *Science* will carry the full text of the new bill 22 February.

Technical Papers

The Ratio of Carotene to Carotenoid Pigments in Sweet-potato Varieties

BOYCE D. EZELL and MARGUERITE S. WILCOX[1]

U. S. Department of Agriculture, Beltsville, Maryland

The sweet potato has long been recognized as a valuable source of carbohydrates in the human diet. More recently its importance as a source of carotene (provitamin A) has been stressed. Sweet potatoes vary greatly in depth of yellow or salmon color, not only between varieties but also within a variety. Depth of color within a variety has been used as a criterion of excellence in the selection of improved strains of some of the standard varieties. If the yellow color of the sweet potato is due to carotene alone, it is readily evident that varieties with deep-colored flesh are much more valuable as a source of provitamin A than are those with lightly-colored flesh. If other carotenoids are also present, then the relative amounts of carotene and other pigments are a matter of interest. This study was made to determine what portion of the yellow pigment in different sweet-potato varieties is carotene.

Matlack (*5*) studied the yellow pigments of the Porto Rico variety. After phasic separation of the extracted pigments, attempts to isolate crystalline xanthophylls from the alcoholic phase proved unsuccessful, but other tests indicated the presence of violaxanthin. Chromatographic adsorption of the recrystallized pigments of the epiphase on a Tswett column of calcium hydroxide gave four colored bands, only the lower band yielding sufficient material for isolation of crystals. He identified these crystals as β-carotene. From these results he concluded that the latter was the predominant pigment of the sweet potato, with a small amount of xanthophylls, one of which was violaxanthin. He gave no data, however, as to what percentage of the total yellow pigments was β-carotene. Lease (*4*) states that the yellow pigment of Porto Rico sweet potatoes is almost entirely β-carotene, and Villere, *et al.* (*6*) working with the same variety, also state that it is the principal carotenoid pigment of sweet potatoes. Other workers have reported carotene as the principal yellow pigment of sweet potatoes. However, little if any quantitative data have been reported as to the relative amounts of various yellow pigments in different varieties of sweet potatoes.

In the work reported here each sample analyzed consisted of 20 grams of a composite of half of each of three to six unpeeled potatoes split lengthwise, ground in a food chopper, and mixed thoroughly before sampling. The Wall and Kelley method (*7*) was used in extracting the pigments and determining the carotene. The aqueous-alcohol fraction contained little, if any, pigments. The ether extract was a clear yellow. The total ether-soluble pigments was determined photoelectrically from the petroleum ether extract before chromatographing, and the carotene after chromatographing. Both were read at a wave length of 460 mμ, and the concentrations calculated from the same concentration curve, prepared from 90 per cent β- and 10 per cent α-carotene.

The mean concentrations of total pigments, carotene, and the carotene/total-yellow-pigment ratio for several varieties of sweet potatoes are given in Table 1. It is readily evident that yellow pigments other than carotene are present in these sweet-potato varieties. A limited number of analyses made on several intervarietal hybrid selections being grown at the Plant Industry Station at Beltsville, Maryland, showed that they too contained other yellow pigments. The ratio of carotene to total yellow pigments varies with different varieties, and the greater the concentration of total pigments, the higher the carotene/total-pigment ratio. In general, this relationship holds true not only within a variety but also within individual roots, as shown in Table 2, in which are presented results for individual roots and portions of roots ana-

TABLE 1

THE CAROTENE AND TOTAL PIGMENTS OF DIFFERENT VARIETIES OF SWEET POTATOES

Variety	No. of samples	Total pigments mg./100 grams* Means ± s $\bar{x}$	Carotene mg./100 grams* Means ± s $\bar{x}$	Ratio $\frac{\text{carotene}}{\text{Total pigments}} \times 100$ Means ± s $\bar{x}$
Maryland Golden ..	42	5.84 ± .086	5.18 ± .083	88.64 ± .46
Porto Rico	48	4.37 ± .066	3.58 ± .068	81.76 ± .70
Nancy Hall	38	1.81 ± .036	1.09 ± .038	60.01 ± 1.40
Vineland Bush ...	49	0.73 ± .018	0.24 ± .010	32.04 ± .84
Southern Queen ..	41	0.47 ± .066	0.13 ± .004	28.29 ± .45
Triumph ..	19	0.40 ± .006	•	•

* Fresh weight basis.
Approximately one-fourth of the pigments at harvest was carotene, but the carotene fraction had disappeared by early December. Samples taken from storage in late May contained a small amount of carotene.

[1] Biochemist and assistant mycologist, respectively, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration.

lyzed separately. These results show the wide variations that may occur within the Porto Rico variety and emphasize the need for care in the selection of propagating stock. No relationship between weight, length, or circumference of the root and the total pigments, carotene, or the carotene/total-pigment ratios was evident in this variety.

TABLE 2

THE CAROTENE AND TOTAL PIGMENTS OF INDIVIDUAL ROOTS OF PORTO RICO SWEET POTATOES

	Total pigments mg./100 grams	Carotene mg./100 grams	Ratio $\frac{\text{carotene}}{\text{Total pigments}} \times 100$
Individual roots	6.95	6.39	91.94
	6.32	5.52	87.34
	5.88	5.05	85.88
	5.66	4.75	83.92
	5.48	4.60	83.94
	4.94	4.13	83.60
	4.81	3.90	81.08
	4.77	3.99	83.64
	4.64	3.90	84.05
	4.47	3.85	86.13
	4.32	3.76	87.04
	4.32	3.65	84.49
	4.21	3.43	81.47
	4.17	3.49	83.69
	4.13	3.51	84.98
	4.13	3.34	80.87
	4.03	3.41	84.61
	3.97	3.26	82.11
	3.92	3.31	84.44
	3.91	3.13	80.05
	3.72	3.11	83.60
	3.70	3.03	81.89
	3.64	2.89	79.39
	3.25	2.56	78.77
	2.82	2.25	79.79
	2.78	2.01	72.30
	2.10	1.46	69.52
Portions of same root			
stem end	6.75	6.08	90.07
center	4.46	3.87	86.77
root end	3.44	2.36	68.60
stem end	5.54	4.59	82.85
center	3.98	3.38	84.92
root end	2.76	2.08	75.36
stem end	5.43	4.72	86.92
center	3.82	3.28	85.86
root end	2.97	2.30	77.44
stem end	3.15	2.39	75.87
center	2.26	1.66	73.45
root end	1.43	.76	53.15

The position of the other pigments on the chromatogram and the tenacity with which they were held indicate that they are different from those known to have provitamin A activity. Neo-β-carotene B or any other carotene of known provitamin A value would probably be carried down in the carotene fraction as here prepared.

Discussion. Kemmerer and Fraps (*2*) have reported that carotene prepared by the usual methods, including that reported here, may contain several fractions, some of which may have no biological activity. Their method calls for adsorption on a column of calcium hydroxide. While suitable for the separation of the various carotene isomers, it is not adapted to rapid routine analysis because of the time-consuming elutions involved.

Kemmerer, Fraps, and Meinke (*3*) have recently reported that the "crude-carotene" of raw sweet potatoes (variety not named) contained, besides β-carotene, neo-β-carotene B and "impurity A." They also found 2 per cent of neo-β-carotene U in one of the five baked samples tested and up to 27 per cent (average, 5 per cent) of this isomer in dehydrated sweet potatoes. No α-carotene was found in any of the samples. "Impurity A" has little if any biological value. Neo-β-carotene B has one-half that of β-carotene, and neo-β-carotene U was reported by Kemmerer and Fraps (*2*) as of no biological value, but Deuel, *et al.* (*1*) reported it as having 38 per cent of the value of β-carotene. According to Kemmerer, Fraps, and Meinke (*3*) the total biological activity of the "crude carotene" in the three samples of raw sweet potatoes tested was equivalent to 88 per cent β-carotene, and in the baked and in the dehydrated samples it was 76 per cent. Whether these figures are representative of all varieties is not known. Kemmerer and Fraps (*2*) reported earlier that both carotenoid X (neo-β-carotene U) and α-carotene were present in fresh sweet potatoes (variety not named) to the extent of 5.4 and 1.4 per cent, respectively, but in a later paper (*3*) reported neither to be present.

Summary. The fleshy roots of the sweet potato are shown to contain appreciable amounts of yellow pigments other than β-carotene. The carotene/total-pigment ratio varies among different varieties and within varieties. In the varieties tested, the carotene/total-pigment ratio increased with increase in intensity of yellow color. Triumph, a very light-colored variety, contained a small amount of carotene shortly after harvest, but this soon disappeared in storage.

References

1. DEUEL, H. J., JR., JOHNSTON, C., SUMNER, E., POLGAR, A. and ZECHMEISTER, L. *Arch. Biochem.*, 1944, **5**, 107.
2. KEMMERER, A. R., and FRAPS, G. S. *Ind. eng. Chem.* (Anal. ed.), 1943, **15**, 714.
3. KEMMERER, A. R., FRAPS, G. S., and MEINKE, W. W. *Food Res.*, 1945, **10**, 66.
4. LEASE, E. J. *Proc. Ass. S. Agric. Workers* (42nd Annual Convention, Atlanta), 1941. P. 162.
5. MATLACK, M. B. *J. Wash. Acad. Sci.*, 1937, **27**, 493.
6. VILLERE, J. J., HEINZELMAN, D. C., POMANSKI, J., and WAKEHAM, H. R. R. *Food Ind.*, 1944, **16**, 76.
7. WALL, M. E., and KELLEY, E. G. *Ind. eng. Chem.* (Anal. ed.), 1943, **15**, 18.

Amino Acid and Protein Deficiencies as Causes of Corneal Vascularization: A Preliminary Report[1]

V. P. SYDENSTRICKER, W. KNOWLTON HALL, CHARLES W. HOCK, and EDGAR R. PUND

University of Georgia School of Medicine, Augusta

The appearance of vessels in the cornea of rats deficient in tryptophane and lysine was first described

[1] This investigation was aided by grants from the John and Mary R. Markle Foundation and Merck and Company.

by Totter and Day (*9*). Albanese and Buschke (*2*) have since observed corneal vessels in the eyes of tryptophane-deficient rats, and recently Albanese (*1*) showed that these vessels were not affected by the administration of riboflavin. We (*5*) have confirmed and extended the observations of Totter and Day with regard to the corneal vascularization which appears in lysine deficiency. This also was neither prevented nor affected by large amounts of riboflavin.

A considerable variety of conditions result in corneal vascularization. In addition to those causes mentioned above, corneal vascularization may result from riboflavin deficiency, vitamin A deficiency, zinc deficiency, thallium poisoning (*3*), or tyrosine poisoning (*6*). Our observations as well as the observations of others indicate that the appearance of corneal vessels is not a universal finding in all deficiencies, though there seem to be causes of corneal vascularization other than those listed above. Machella and McDonald (*8*) report a series of patients who showed the accepted clinical picture of riboflavin deficiency including corneal vascularization, but none of whom showed any marked improvement on treatment with riboflavin. Lyle, Macrae, and Gardiner (*7*) determined the degree of corneal vascularization in about 4,000 RAF personnel at 10 stations in England and 12 stations overseas. Of the vascularization observed, some was apparently due to riboflavin deficiency and responded to treatment with this factor. However, their experiments suggested that other factors present in fruits and vegetables influenced the vascularization more than riboflavin. No definite evidence of improvement was found following treatment with the other pure vitamins tried, but the most definite benefit was obtained where the diet was supplemented by a good variety of nutritious foodstuffs. They thought that the degree of corneal vascularization in their groups of subjects was a reliable index of the general state of nutrition of the group, although it seemed that the corneal vascularization of some of the subjects was due to causes other than nutritional deficiency since there was no response to a superior diet.

Recently we have investigated the effect of methionine deficiency in the production of corneal vascularization. Of 44 rats from 8 litters of Wistar rats placed on methionine-deficient diets[2] at weaning or shortly after, 8 developed corneal vessels seen with the biomicroscope. This observation was confirmed by examination of histological sections of the eyes of some of the rats. The rats were fed daily from amber glass stock bottles of the diet which were kept in the cold. The average daily riboflavin intake of the four rats on the methionine-deficient diet calculated from food consumption was 70 μg. per rat. Since 30 μg. of riboflavin per week protects rats against riboflavin-deficiency cataracts (*4*), this would appear to be an ample riboflavin intake.

Since corneal vessels seem to result in rats on lysine-, tryptophane-, and methionine-deficient diets, it occurred to us that the development of corneal vessels might be a general effect resulting from a deficiency of protein or amino acids. Accordingly, we placed a litter of four Wistar rats on a protein-free diet[3] when they were 30 days of age. Although some eye changes such as a moderate degree of corneal opacity resulted, no vessels were observed with the biomicroscope. The animals died in an average of 31 days after they were placed on the diet. We have found that with severe nutritional deficiencies the animals may die before the corneal vessels appear, even though the vessels do appear when the deficiency is less severe, so a litter of three Wistar rats 41 days of age was next placed on the same diet. Definite invasion of the cornea by vessels was observed with the biomicroscope between the fourteenth and sixteenth days on the diet in two out of three rats. When the two rats died after 36 days on the diet, vascularization and other corneal changes were well advanced. The third rat at no time showed any corneal vessels.

Since that time 15 Wistar rats from seven litters have been placed on the same protein-free diet and 11 control rats from the same seven litters were fed with a diet containing protein.[4] These rats varied in age from 50 to 62 days at the time they were placed on the diets. In from 9 to 20 days, all the rats showed definite invasion of the cornea by vessels on biomicroscopic examination, and none of the control rats over a period of six weeks have shown more than normal variation on biomicroscopic examination of their eyes. These findings have been confirmed by histological section of the eyes of some of the rats. The riboflavin intake of the rats on the protein-deficient diet as calculated from the feed records averaged 98 μg. per rat per day.

As Buschke (*3*) has pointed out, the rat seems particularly susceptible to vascularization of the cornea, and as a consequence, the question of the applicability of studies of this sort to human nutrition is a matter of interest. In this connection one of us[5] has made the following observations: In May 1945, a biomicroscopic examination was made of some 200-odd in-

[2] The composition of the methionine-deficient diets was: cottonseed oil, 30 grams; cod-liver oil, 20 grams; salt mixture, 40 grams; choline, 2 grams; calcium pantothenate, 20 mg.; thiamin chloride, 4 mg.; pyridoxin, 4 mg.; riboflavin, 16 mg. The diets contained 90, 100, or 110 grams of vitamin-free casein and sufficient sucrose to make a kilo. The salt mixture is as used by J. M. McKibben, *et al. Amer. J. Physiol.*, 1939, **128**, 102.

[3] Same as methionine-deficient diet except that sucrose was added in place of casein.

[4] Same as methionine-deficient diet except that it contained 240 grams of the casein.

[5] V. P. Sydenstricker.

habitants of Leyden, The Netherlands, who were selected at random from the population. Ten per cent were suffering from famine edema. None of the individuals examined showed corneal vessels.

From this, it would appear that while deficiencies of any of three different indispensable amino acids or of protein may result in corneal vascularization in the rat, further investigation is necessary before the significance of these findings with reference to human nutrition becomes clear.

References

1. Albanese, A. A. *Science*, 1945, **101**, 619.
2. Albanese, A. A., and Buschke, W. *Science*, 1942, **95**, 584.
3. Buschke, W. *Arch. Ophthal.*, 1943, **30**, 735.
4. Day, P. L., Darby, W. J., and Langston, W. C. *J. Nutrition*, 1937, **13**, 389.
5. Hock, C. W., Hall, W. K., Pund, E. R., and Sydenstricker, V. P. *Fed. Proc.*, 1945, **4**, 155.
6. Hueper, W. C., and Martin, G. J. *Arch. Path.*, 1943. **35**, 685.
7. Lyle, T. K., Macrae, T. F., and Gardiner, P. A. *Lancet*, 1944, **1**, 393.
8. Machella, T. E., and McDonald, P. R. *Amer. J. med. Sci.*, 1943, **205**, 214.
9. Totter, J. R., and Day, P. L. *J. Nutrition*, 1942, **24**, 159.

Dehydroascorbic Acid in Cabbage

Thelma J. McMillan and E. Neige Todhunter

Laboratory of Human Nutrition, University of Alabama

In analyzing school lunches for ascorbic acid content using the method of Roe and Oesterling (*3*), dehydroascorbic acid was found to be present in appreciable amounts. The average content for 55 plate lunches was 14.8 mg. of reduced ascorbic acid and 5.9 mg. of dehydroascorbic, giving a total of 20.7 mg. (*2*). Thus, there was 40 per cent more ascorbic acid present than would have been accounted for by the usual indophenol procedure.

These findings prompted us to question whether the reported losses of ascorbic acid in cabbage, when prepared as salad and allowed to stand, could be accounted for, at least partially, as dehydroascorbic acid. The destructive effect of metallic catalysts and time of chopping have been noted by several investigators, but in few studies has the reversibly oxidized form of the vitamin been reported. The method of Roe and Oesterling is sensitive to small amounts of ascorbic acid and is not open to some of the criticisms of the hydrogen sulphide method.

Values for fresh cabbage were obtained from a wedge cut from the intact head and immediately immersed in acid and then ground in a Waring blendor. The remainder of the head was cut within five minutes, either with a knife or a hand shredder, and samples taken for analyses at regular intervals. Reduced ascorbic acid was determined by the method of Loeffler and Ponting (*1*) and dehydroascorbic acid and total ascorbic acid by the diphenylhydrazine procedure of Roe and Oesterling (*3*).

Typical results are given in Table 1. When the cabbage was chopped with a knife there was a 13.5 per cent loss of reduced ascorbic acid after standing 120 minutes. However, the values for dehydroascorbic acid indicated that this was not a true loss but that a large portion was changed to the reversibly oxidized form. The total ascorbic acid at the end of 120 minutes was 5.8 per cent less than at the beginning; thus, there was a small destruction of the vitamin during this holding period. Shredding with a hand grater caused a total destruction of 4.7 per cent of the vitamin; with this method of preparation there was an increase in the amount converted to dehydroascorbic acid.

TABLE 1

Ascorbic Acid Content of Cabbage After Cutting and Shredding (mg./100 grams)

Flat Dutch Cabbage	Knife			Shredder		
	Reduced	Dehydro	Total	Reduced	Dehydro	Total
Before cutting	47.3	4.3	50.1	47.6	6.1	53.1
Immediately after cutting	41.5	10.4	49.4	35.5	15.1	52.2
15 minutes after cutting	40.6	10.8	46.3	35.7	17.1	52.3
30 minutes after cutting	40.4	9.1	46.1	34.9	15.7	51.3
60 minutes after cutting	41.1	8.8	49.2	35.3	15.6	52.5
120 minutes after cutting	40.9	8.5	47.2	36.3	14.3	50.6

The average values for all heads of cabbage are shown in Table 2. There was a 5-per cent loss of total ascorbic acid when shredded and held for 120 minutes. The maximum loss occurred in the first 15 minutes and did not increase on standing.

TABLE 2

Per Cent of the Total Original Ascorbic Acid Present as Reduced, Dehydro- and Total Ascorbic Acid

Treatment	Knife cut (4 heads)			Shredded (5 heads)		
	Reduced	Dehydro	Total	Reduced	Dehydro	Total
Before cutting	99.9	8.4	100.0	92.9	10.3	100.0
After cutting	88.0	10.9	96.3	67.7	30.7	97.0
15 minutes after cutting	86.8	20.0	97.2	66.1	32.5	95.2
30 minutes after cutting	87.7	19.4	93.8	65.5	29.9	96.1
60 minutes after cutting	87.5	17.9	97.2	66.2	29.2	95.2
120 minutes after cutting	89.3	16.6	98.4	67.6	26.8	95.1

When cabbage was cooked by boiling for 12 minutes and then held on the steam table for two hours, there was marked destruction of the vitamin. Only 25 per cent of the total ascorbic acid present in the freshly cooked cabbage was retained, and 50 per cent of the

total amount present was in the form of dehydroascorbic acid.

The importance of analyzing raw and cooked foods for dehydroascorbic acid is demonstrated. The general assumption has been that this form of the vitamin is equally as well utilized as is reduced ascorbic acid. Since evidence on this point is incomplete, the utilization of dehydroascorbic acid by human subjects is now being investigated in this laboratory.

References

1. Loeffler, H. J., and Ponting, J. D. *Ind. eng. Chem.* (Anal. ed.), 1942, **14**, 846.
2. McMillan, T., and Todhunter, E. N. In press.
3. Roe, J. H., and Oesterling, M. J. *J. biol. Chem.*, 1944, **152**, 511.

Buckwheat as a Source of Rutin

James F. Couch, Joseph Naghski, and Charles F. Krewson

Eastern Regional Research Laboratory,[1] *Philadelphia*

The recent discovery that the flavonol glucoside, rutin, is effective in the treatment of increased capillary fragility associated with hypertension (*2*) in man has led to a widespread demand for supplies of the drug by physicians and pharmacologists. Preliminary reports indicate that rutin therapy is successful in controlling conditions due to this type of fragility, such as certain cases of retinal hemorrhage and apoplexy.

In this laboratory, rutin was first isolated from tobacco, and the glucoside supplied for the early clinical experiments was prepared from the flue-cured type of high quality. The low yields from an expensive raw material were reflected in a high cost for the product. It was, therefore, desirable to find a more economical source for the glucoside.

A number of plants were examined for rutin content in the course of this research. Of all the species examined, buckwheat is the most promising source yet discovered.

Rutin was first discovered in buckwheat by E. Schunck (*3*), who states that he isolated 240 grains of glucoside from 30 pounds of fresh leaves, a yield of 0.11 per cent. Wunderlich (*4*) obtained "more than 2 per cent" from the dried blossoms of the plant. Brandl and Schärtel (*1*) reported 1.78 per cent from fresh leaves, 0.71 per cent from fresh flowers, 0.09 per cent from the stems, and 1.02 per cent from the dried whole plant.

During the Summer of 1944, forty-six collections of buckwheat of the Japanese variety were made from four scattered localities and examined for rutin.[2] The results showed that the content of rutin was often considerably in excess of that indicated in the earlier reports. In four cases, yields of more than 6 per cent were recorded, and the over-all average for all samples was definitely higher than previously reported.

TABLE 1

Rutin Content of Fresh Buckwheat

Part	Number of samples	Rutin content*		
		Average	Maximum	Minimum
		Per cent	Per cent	Per cent
Whole plant†	28	2.07	8.56	0.43
Leaves and blossoms	13	2.50	6.37	1.16

*Moisture-free basis.
† Exclusive of roots.

The leaves contain more rutin than other tissues of the plant. In one case, the leaves and blossoms together contained 6.37 per cent rutin, the leaves 7.92 per cent, and the blossoms 4.15 per cent. The stems contain only small quantities, 0.4 per cent being the largest found. The seeds and flour were free of rutin.

An experiment conducted with one crop and in a single season indicated that the rutin content varies with the age of the plant, being greatest in the early blossoming stage. Collections of the whole plant, minus roots, were made weekly throughout the growing season until the plant had gone to seed. The rutin content was determined for each collection. The results are presented in Table 2.

TABLE 2

Variation of Rutin Content of Buckwheat With Age of Plants

Time from planting (days)	Stage of maturity of plants	Moisture, per cent	Rutin,*† per cent	Rutin per plant, mg.	Rutin, per acre, lbs.
12	4-leaf	91.2	0.92	0.87	1.86
19	6-leaf, flower buds forming	89.5	2.50	5.4	10.86
26	1–3 blossom heads in bloom	87.9	2.98	6.9	14.18
33	24"–30" tall, in bloom	91.9	2.47	19.1	39.3
40	36" tall, in bloom	86.9	1.76	24.2	50.25
47	Seeds setting	85.0	1.21	23.5	48.5
54	All seeds set, one-fourth dark	78.6	0.99	27.3	56.3
61	About one-half of seeds dark	80.2	0.62	19.0	39.2
68	All seeds dark	77.8	0.47	19.5	40.2

* Average of duplicate analyses.
† Moisture-free basis.

The data show the rapid increase in rutin content, which reached a maximum in 23 days after emergence

[1] One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

[2] The method of analysis was essentially that of C. E. Sando and J. U. Lloyd. *J. biol. Chem.*, 1924, **58**, 737.

from the ground (26 days after planting) and thereafter declined gradually as the plant went to seed. A part of the decrease in rutin concentration was due to the relatively faster growth of stem tissues, which contain less rutin than the leaves and blossoms, and later in the season, to atrophying of leaf tissues and replacement of blossoms by seeds. The weight of rutin per plant, however, reached a maximum in 37 to 51 days from emergence and then was 3.5 to 4 times as great as at the time of greatest concentration, the plants having increased 6 to 12 times in weight during the two- to four-week period. On an over-all yield basis, one acre of buckwheat in 26 days from planting would produce 14.2 pounds of rutin, while in 40 days the yield would be 50.25 pounds, or approximately 3.5 times as much.

Storage of the crop presents some difficulties because of the tendency of rutin to disappear as the plant dries. Buckwheat exposed to the sun as in haymaking does not dry quickly or thoroughly and loses rutin rapidly. Experiments conducted to determine the effect of drying conditions upon the rutin content showed that the loss of rutin usually increased as the drying process was prolonged, especially at moderate temperatures. Some typical cases are presented in Table 3.

TABLE 3

LOSS OF RUTIN ON DRYING BUCKWHEAT

Sample number	Manner of drying	Rutin content* of		Loss Per cent
		Undried plant Per cent	Dried plant Per cent	
32	Dried in air 4 days, then at 110° overnight	2.50	0.71	71.6
34	Dried† at 135° for 22 minutes	2.12	1.36	35.8
34	Dried† at 71° for 135 minutes	2.12	.00	100.
34	Dried at 110° for 19 hours	2.12	0.59	72.2
35	Dried† at 105° for 50 minutes	2.98	0.84	71.9
35	Dried at 92–100° for 4 hours	2.98	0.81	72.8
37	Dried at 92–100° for 6 hours	2.47	1.53	38.1
37	Dried at 105° for 40 minutes	2.47	1.52	38.1

* Moisture-free basis.
† Chopped.

When the buckwheat is thoroughly dried the rutin content appears to be stable, no loss being observed in specimens stored for six months or more.

References

1. BRANDL, J., and SCHÄRTLE, G. *Arch. Pharm.*, 1912, **250**, 414–417.
2. GRIFFITH, J. Q., JR., COUCH, J. F., and LINDAUER, M. A. *Proc. Soc. exp. Biol. Med.*, 1944, **55**, 228–229.
3. SCHUNCK, E. *Mem. lit. phil. Soc. Manchester*, 1860, Ser. 2, **15**, 122–129.
4. WUNDERLICH, A. *Arch. Pharm.*, 1908, **246**, 241–256.

Thiamine Depletion of Human Subjects on a Diet Rich in Thiamine[1]

HELEN T. NESS, ECHO L. PRICE, and HELEN T. PARSONS

Department of Home Economics, University of Wisconsin

Studies on thiamine balance in human subjects have usually been carried out with restrictions in dietary intake, with recovery or therapeutic test doses administered after deficiency symptoms have been produced, or, more recently, with enzymatic destruction of thiamine in the digestive tract.

In this laboratory it has been found that by supplementation of an adequate basal diet with certain viable fresh bakers' yeasts it is possible to produce within a period of days a strikingly low excretion of urinary thiamine. In a series of nine tests, five college women in a satisfactory nutritional state were fed a basal diet consisting of bread, pineapple, and dairy products which provided 1.6 mg. of thiamine per day. In order to further insure satisfactory body stores 2 mg. of thiamine hydrochloride were added daily to the subjects' self-selected diets for a 3-day period 24 hours prior to ingestion of the basal diet. The diet sequence was one of three periods: a yeast-supplement period during which either 15 or 150 grams of the live, fresh bakers' yeast containing 7 μg. of thiamine per gram, of a yeast type previously shown not to yield its thiamine for absorption (*4*), was ingested in addition to the basal diet; the yeast period was immediately preceded and followed by a yeast-free basal period.

The interference of the yeast with the availability of dietary thiamine from other sources and the resulting decrease in thiamine output are recorded in Table 1. The trend was obvious during the 15-gram dosage as well as on 150 grams of yeast. The sharpest decline occurred in all cases within the first 4 days after which fluctuations at the low level of approximately 50 μg. of thiamine excretion persisted in the case of the larger dosage, a decline twice as great as that produced by the smaller amount. In like manner, when the larger amount was continued for 10 instead of 6 days, the recovery of higher urinary concentrations upon resumption of the yeast-free diet was measurably slow, indicating a possible depletion of body stores. That the interference was a function of the viability of the yeast was indicated not only by the greater decrease in urinary thiamine excretion on the larger dosage, but also by the decided increases in the

[1] This work was supported in part by a grant from the Wisconsin Alumni Research Foundation and in part from Purnell funds and a grant from the Pineapple Research Institute of Hawaii.

output when the fresh yeast was heated to the temperature of boiling water just before ingestion (Table 1). It should be noted that the yeast was fed immediately before each meal to permit the possibility of blending with the food. The capacity for viable yeast to withdraw thiamine from a surrounding medium has been well authenticated (*1*). Fecal thiamine concentrations observed during the various periods showed an inverse relationship to urinary thiamine concentrations, indicating that this is a withholding process by the viable yeast rather than destruction within the digestive tract.

TABLE 1

URINARY THIAMINE* EXCRETION ON YEAST-SUPPLEMENTED DIET

Period	Days of period	Grams yeast ingested: 15 grams (3 subj.)	150 grams 3 subj.†	150 grams (3 subj.)
		μg. thiamine/ day	*μg. thiamine/ day*	*μg. thiamine/ day*
Basal	3 or 6 days	374‡	312‡	332‡
Basal plus live yeast	6 or 10 days	217	168	161
		178	124	109
		158	107	99
		163	84	29
		163	52	49
		101	50	33
		...	...	62
		...	...	49
		...	...	42
		...	...	40
Basal	3 days	212	189	80
		227	232	141
		242	257	198
Basal plus boiled yeast	3 days		372	
			712	
			702	

* Thiochrome Assay Method.
† Two subjects, only, ingested boiled yeast.
‡ Values are daily averages for entire period.

While the low values observed in the present experiment do not approach the zero excretions reported in long-term investigations such as those of Keys (*3*) with acute deprivation of B-vitamins following a long period of mild depletion, they are within the range accepted as denoting "considerable to severe deficiency" (*2*).

This procedure may possibly have an application in certain short-term experiments, in that rapid depletion of thiamine may be achieved without the use of a quantitative or deficient diet, and thiamine stores may be quickly regained by merely discontinuing the yeast from the basal adequate diet.

References

1. HOCHBERG, M., MELNICK, D., and OSER, B. *J. Nutrition*, 1945, **30**, 201.
2. HOLT, L. E. *Proc. Fed. Amer. Soc. exp. Biol.*, 1945, **3**, 158.
3. KEYS, A., HENSCHEL, A., TAYLOR, H. L., MICHELSON, O., and BROZEK, J. *Amer. J. Physiol.*, 1945, **144**, 5.
4. WILLIAMSON, A., and PARSONS, H. T. *J. Nutrition*, 1945, **29**, 51.

Effect of Methionine Supplements on Hepatic Injury Produced by Carbon Tetrachloride[1]

VICTOR A. DRILL and TED A. LOOMIS

Department of Pharmacology, Yale University School of Medicine

It was first observed by Hershey and subsequently by Best and collaborators that choline exerts a lipotropic effect. Since then numerous studies have been performed on the relation of choline, methionine, and cystine to fat metabolism with special reference to hepatic changes (*6*). However, little work has been reported on the relationship of dietary choline and methionine to functional changes in the liver. It was demonstrated by Hough and Freeman (*4*) that removal of protein from the diet resulted in an increase in serum phosphatase and a decreased hepatic clearance of dye. They later reported that choline chloride prevented these changes during the first 8 weeks of the deficient diet (*5*). It is also known that such protein-depleted dogs are more susceptible to hepatic poisons. Miller and Whipple (*7*) noted that the toxicity of chloroform in protein-depleted dogs was decreased when methionine was administered either before or up to four hours after the chloroform anesthesia. The methionine-treated animals survived a period of anesthesia lethal to untreated animals. In similar studies Goodell, *et al.* demonstrated that the rise in icterus index following the administration of mapharsen to protein-depleted dogs was lessened when methionine was also given (*2*).

In the above experiments the beneficial effects of methionine were obtained in animals maintained on practically protein-free diets. It is of interest to determine if methionine supplements to a normal protein diet exert any protective action against hepatic toxins. No studies have appeared on this subject, and the following data, pertinent to this question, are reported.

Liver damage was produced by administering small doses of carbon tetrachloride to healthy, adult dogs. The CCl_4 was mixed with an equal volume of corn oil and given by stomach tube before the dogs were fed. Changes in hepatic function were studied by means of the bromsulphalein and serum phosphatase tests, as they have been shown to be sensitive methods in detecting liver damage produced by CCl_4 (*1*). Serum phosphatase was determined by the method of Bodansky (*1*) and bromsulphalein retention by the

[1] This study was aided by a grant from Eli Lilly and Company, Indianapolis, and by the Fluid Research Fund of Yale University School of Medicine. The authors also wish to thank Eli Lilly and Company and Wyeth and Company for the necessary methionine.

method of Rosenthal and White.[2] The dogs were fed a synthetic diet containing either 41 per cent or 20 per cent of casein.[3] The 20-per cent casein diet is at the lower level of protein intake but is still normal, and either diet will maintain a normal hepatic function in dogs. All animals received the synthetic diet for at least four weeks before CCl_4 was administered. The methionine was injected intravenously, 1.0 gram being dissolved in 20 cc. of distilled water.

Experiment 1. In this initial study the dogs received the 41-per cent casein diet. One-half cc. of CCl_4 per kilo of body weight was administered on days 1 and 5 of the study and liver function tests performed on the eighth day (Table 1). The methionine-treated animals received 1.0 gram on days 1, 2, 5, and 6. No protective effect of the methionine on liver function was observed (Table 1).

Experiment 2. It was thought that methionine may not exert any protective effect when supplementing a 41-per cent casein diet. Therefore, in this study the amount of casein was reduced to 20 per cent. The dose of CCl_4 was also reduced to 0.25 cc. per kilo of body weight and administered on days 1, 3, and 5. Hepatic function tests were performed two days after each preceding dose of CCl_4 (Table 1). Of the methionine-treated dogs, No's 11 and 12 received 1.0 gram of methionine morning and afternoon each day, starting with the first administration of CCl_4. Animal No. 10 received only 1.0 gram of methionine every day. No significant protective effect of the methionine on hepatic function was noted (Table 1).

Experiment 3. It was possible that the dose of CCl_4 in the previous experiment was too high and might overshadow any effect of the methionine. Therefore in this study the amount of casein was reduced to 20 per cent. The dose of CCl_4 was also lowered to 0.125 cc. per kilo of body weight and administered on days 1, 3, 5, and 7. Hepatic function tests were performed on days 3, 5, 7, and 9. Two grams of methionine were injected each day as in Experiment 2. The methionine was not observed to exert any protective effect on the hepatic functions tested (Table 1).

TABLE 1

EFFECT OF CARBON TETRACHLORIDE AND METHIONINE ON BROMSULPHALEIN RETENTION AND SERUM PHOSPHATASE

Days of Exp.		Bromsulphalein retention						Serum phosphatase					
		CCl_4				CCl_4 + methionine		CCl_4				CCl_4 + methionine	
Exp. 1. 41% casein diet, 0.5 cc. CCl_4/kg.													
	Dog No.	1	2	3	4	5	6	1	2	3	4	5	6
Control		2	3		5	3	2	4.40	2.67		4.50	3.15	5.13
Control		2	2	4	4	2	2	4.38	3.63	4.50	4.99	1.45	2.10
8		20	38	14	14	40	38	23.75	4.90	4.70	5.62	20.48	20.00
Exp. 2. 20% casein diet, 0.25 cc. CCl_4/kg.													
	Dog No.	7	8	9		10	11	12	7	8	9	10	11	12
Control		2	4	3		3	4	2	5.75	3.95		4.55	2.40	5.25
Control		3	5	3		4	4	4	5.25	3.38	6.75	4.65	4.15	4.50
3		3	6	40		8	2	3	4.00	1.88	10.71	6.50	3.00	9.67
5		24	60	60		8	60	40	6.36	4.88	16.75	5.00	3.58	9.50
7		95	90	95		95	95	60	16.70	7.50	26.80	17.50	10.50	18.15
Exp. 3. 20% casein diet, 0.125 cc. CCl_4/kg.													
	Dog No.	13	14	15		16	17	18	13	14	15	16	17	18
Control		3	2	3		3	2	2	4.25	3.88	5.00	4.23	5.64	5.75
3		4	3	5		6	5	6	3.95	3.68	5.08	5.03	4.50	5.38
5		22	6	5		38	45	6	8.43	3.00	5.60	6.75	8.00	4.00
7		45	10	4		30	50	18	6.25	2.75	3.75	9.50	9.88	6.25
9		95	18	25		24	100	60	6.75	4.00	3.57	6.63	8.18	8.50

It has been definitely shown that the reduced hepatic resistance to chloroform and mapharsen in dogs fed a protein-free diet can be counteracted by the administration of methionine (*2, 7*). Under the conditions of the above experiments methionine did not exert any demonstrable protective effect on the hepatic damage produced by CCl_4 in dogs fed a normal amount of protein, either 20-per cent or 41-per cent casein. This can be seen with both the bromsulphalein and serum phosphatase tests. Generally the bromsulphalein test became abnormal before or at the same time as the serum phosphatase values, confirming previous results with these two tests. In only one dog (No. 12) did the phosphatase values become abnormal before the dye test. Some variation is present in that one methionine-treated dog (No. 10) maintained a normal liver function longer than un-

[2] The customary dose of 5 mg./kilo of body weight was injected instead of the original 2-mg. dose. A single blood sample was taken one-half hour later, and the concentration of dye present divided by 2½.

[3] Diet consisted of: casein, 41.2 per cent; sucrose, 33.4 per cent; lard, 21.5 per cent; bone ash, 2.6 per cent; salt mixture (Karr), 1.3 per cent. In the 20-per cent casein diet the sucrose was increased to 54.6 per cent. Four grams of brewer's yeast concentrate was given each day to supply the B vitamins, and 10 drops of oleum percomorphum were added to each kilo of diet.

treated controls. However, the variation was such that in the other two experiments the dogs receiving methionine showed a somewhat earlier and greater degree of liver damage.

This failure of supplementary methionine in a normal protein diet to protect against CCl_4 liver damage may be likened to the failure of supplementary thiamine to produce any added effect in the presence of an adequate vitamin intake. From the present experimental studies one would expect a beneficial effect of methionine or choline on an abnormal hepatic function only in the face of a previous history of protein deficiency. To date three studies have failed to find any beneficial effect of methionine or choline in homologous serum jaundice (*11*) or in infectious hepatitis (*3, 12*). On the other hand, choline, in combination with high protein and high vitamin diets, has been reported to be of value in the treatment of hepatic cirrhosis (*8, 10*), but not all are in agreement with this point (*10*). Experimentally, a protective effect of supplements of methionine added to a normal diet might later be demonstrated with another type of liver damage. The above experiments are fairly acute, and when larger amounts of methionine are available some effect may be demonstrated on a more chronic liver damage. Studies on hepatic repair are also needed as previous studies are all prophylactic in nature.

Summary. At the present time the experimental evidence demonstrates that supplements of methionine will decrease the degree of liver damage produced by toxic agents in protein-depleted animals. In animals receiving a normal protein intake of 20-per cent or 41-per cent casein, methionine supplements did not decrease the degree of hepatic damage produced by carbon tetrachloride as judged by serum phosphatase values or bromsulphalein retention.

References

1. Drill, V. A., and Ivy, A. C. *J. clin. Invest.*, 1944, **23**, 209.
2. Goodell, J. P. B., Hanson, P. C., and Hawkins, W. B. *J. exp. Med.*, 1944, **79**, 625.
3. Higgins, G., O'Brien, J. R. P., Peters, R. A., Stewart, A., and Witts, L. J. *Brit. med. J.*, 1945, **1**, 401.
4. Hough, V. H., and Freeman, S. *Amer. J. Physiol.*, 1942, **138**, 184.
5. Hough, V. H., Monahan, E. P., Li, T., and Freeman, S. *Amer. J. Physiol.*, 1943, **139**, 642.
6. McHenry, E. W., and Patterson, J. M. *Physiol. Rev.*, 1944, **24**, 128.
7. Miller, L. L., and Whipple, G. H. *J. exp. Med.*, 1942, **76**, 421.
8. Rimmerman, A. B., Schwartz, S. O., Popper, H., and Steigmann, F. *Amer. J. digest. Dis.*, 1944, **11**, 401.
9. Rosenthal, S. M., and White, E. C. *J. Amer. med. Ass.*, 1925, **84**, 1112.
10. Russakoff, A. H., and Blumberg, H. *Ann. int. Med.*, 1944, **21**, 848.
11. Turner, R. H., Snavely, J. R., Grossman, E. B., Buchanan, R. N., and Foster, S. O. *Ann. int. Med.*, 1944, **20**, 193.
12. Wilson, C., Pollock, M. R., and Harris, A. D. *Brit. med. J.*, 1945, **1**, 399.

In the Laboratory

Inhibition of Oxidation of Ascorbic Acid by Certain Vegetable Extracts

Ruth Reder

Oklahoma Agricultural Experiment Station, Stillwater

Aqueous extracts of a number of vegetables exert an inhibitory effect on the oxidation of ascorbic acid. Evidence of this effect was first obtained when, to avoid errors in sampling, an attempt was made to use an extract of cabbage, rather than the vegetable itself, in a study of the effects of various compounds on the oxidation of ascorbic acid during boiling. When an aqueous extract of cabbage containing added ascorbic acid was boiled, it was observed that only a small percentage of the vitamin was oxidized. The inhibition of oxidation was found not to be caused by a hydrogen-ion concentration unfavorable to the oxidation, although it was influenced by this factor; nor was it an apparent effect resulting from the formation or release of ascorbic acid or other reducing substances during boiling. Similar aqueous extracts of other vegetables were found to differ widely in their capacity to inhibit oxidation.

Both fresh and previously boiled extracts produced inhibition; the latter were used in the present experiments. The extracts were prepared by grinding a weighed amount of the fresh vegetable with water in a Waring blendor; the filtrate from the blended mixture was boiled for 30 minutes, chilled, filtered, and made to volume. One milliliter of extract was equivalent to 0.25 gram of fresh material.

Inhibition of oxidation was determined by the difference between the amounts of ascorbic acid oxidized, during the same boiling period, in equal volumes (40 ml.) of two solutions (buffered or unbuffered) containing the same amount of ascorbic acid, but differing in that one solution contained a known amount of vegetable extract. The reaction mixtures, complete except for the ascorbic acid, were brought to boiling in uncovered 150-ml. beakers containing glass beads,

and a known amount of ascorbic acid solution added to each. At the end of the boiling period, an equal volume of 6-per cent metaphosphoric acid was added to each solution. The solutions were cooled and their ascorbic acid content determined by the titration method.

The inhibition produced by a given amount of extract was found not to be affected by the length of the boiling period; the percentage inhibition produced in triplicate reaction mixtures, boiled for 5-, 10-, and 15-minute periods, was constant. It was influenced, however, by the amount of ascorbic acid present. In buffered (pH 5.7) reaction mixtures containing 1.0 mg. of ascorbic acid, 2 ml. of extracts of lettuce, cabbage, and cauliflower produced 50.0, 79.2, and 91.7 per cent inhibition, respectively, while in similar reaction mixtures containing 8.0 mg. of ascorbic acid these extracts produced 16.0, 53.8, and 71.7 per cent inhibition, respectively.

In reaction mixtures containing a fixed amount of ascorbic acid, increasing amounts of an extract produced an increasing inhibition until a maximum was reached. The maximal inhibition produced by extracts of different vegetables varied: in unbuffered reaction mixtures containing 1.0 mg. of ascorbic acid the maximal inhibition produced by extracts of 10 vegetables ranged from 86 to 47 per cent. The vegetables, when listed according to their decreasing capacity to inhibit the oxidation of ascorbic acid, fall in the following order: Brussels sprouts, green beans, squash, Irish potatoes, broccoli, cauliflower, cabbage, spinach, sweet potatoes, and lettuce. Extracts of all but the last three vegetables produced an inhibition of 70 per cent or more. Two to 4 ml. (0.5–1.0 gram of fresh material) were required to produce maximal inhibition.

The inhibition produced by the extracts was closely associated with copper. In reaction mixtures containing fixed amounts of ascorbic acid and vegetable extract, the percentage inhibition was found to decrease as the amount of copper, added as $CuCl_2H_2O_3$, was increased. Conversely, in solutions containing fixed amounts of ascorbic acid and of added copper, increasing amounts of extract produced an inhibition which increased until a maximum was reached; the maximal inhibition produced varied with the level of added copper.

Results of experiments carried out with extracts at room temperature have confirmed those obtained during boiling. For example, unbuffered reaction mixtures of equal volume (50 ml.) containing 5 mg. of ascorbic acid and 2.0 ml. of extracts of cauliflower and cabbage retained 52.4 and 44.7 per cent, respectively, of their ascorbic acid content after standing at room temperature for 9 hours, whereas only 9.6 per cent of the vitamin remained in a control solution containing no vegetable extract. In similar solutions containing 20 μg. of added copper 16.6, 5.4, and 0 per cent, respectively, of the ascorbic acid was retained after 9 hours.

Of a number of substances examined, those containing either or both the –SS- and –SH groups have been found to exert an inhibitory effect during boiling similar to that exhibited by aqueous extracts of vegetables; these were cystine, cysteine, and an aqueous extract of papain (either fresh or previously boiled). It appears possible that the inhibition of oxidation of ascorbic acid by vegetable extracts may be attributed, in part, to the presence of these groups.

The Use of 2,4-Dinitrophenylhydrazine for the Determination of Ascorbic Acid [1]

M. Pijoan, Lt. Cdr. (MC), USNR, and H. J. Gerjovich, PhM2/c V6 SV, USNR
Naval Medical Research Institute, Bethesda, Maryland

The assay of ascorbic acid by the method of Roe and Kuether (*6*) is based on the reaction of dehydroascorbic acid with 2,4-dinitrophenylhydrazine to form an osazone which, on treatment with sulfuric acid, results in a colored dehydration product. This procedure, when used for blood as recommended by Roe and Kuether, gives excellent results. When applied to certain freshly prepared synthetic or biologically derived ascorbic acid solutions, it gave results which generally conformed to the values obtained by using the oxidation-reduction indicator 2,6-dichlorobenzenone indophenol and those obtained by biological assay (*5*). Thus, so far, it appears reliable for blood and for certain freshly prepared biological materials.

This communication concerns itself with errors inherent in the procedure if applied to biological material or ascorbic acid solutions where unpredictable antecedent oxidation of the vitamin has occurred. We were surprised when a 10-day stock preparation of orange juice, which had been sufficiently aerated to oxidize most of the ascorbic acid (0.2 mg. per cent remaining unoxidized) but which contained 60–70 mg. per cent of "vitamin C" (as dehydroascorbic acid) as determined by the phenylhydrazine method (*6*), failed to prevent the occurrence of scurvy in guinea pigs on a vitamin C-free diet. It was the purpose of the original experiment to demonstrate that the vitamin C potency of a food was not dependent entirely on its ascorbic acid content. The animals received a daily intake of 1.5 mg. of presumed dehydroascorbic acid and yet developed the gross and microscopic lesions

[1] The statements and opinions set forth in this article are those of the authors and not necessarily those of the Navy Department.

of scurvy in four weeks, whereas the control group on a similar amount of the vitamin in fresh juice did not become diseased. The orange juice was then treated with H_2S (*2*) and found to contain only 4 mg. per cent of dehydroascorbic acid. It seemed unlikely, therefore, that the high value obtained by the phenylhydrazine method was due to vitamin C (to include ascorbic acid and dehydroascorbic acid). It was more likely that mutarotation had occurred with loss of lactone structure (*2*) and formation of diketogulonic acid. Similar results, obtained with synthetic ascorbic acid, are presented in Table 1.

From these data it is apparent that the phenylhydrazine reaction is not necessarily specific for dehydroascorbic acid. This is borne out by previous studies which show that 2,4-dinitrophenylhydrazine reacts with diketogulonic acid (*3*), possibly phenylpyruvic acid (*4*), and other alpha-keto acids (*7*).

Thus, the 2,4-dinitrophenylhydrazine method may give unreliable results for the antiscorbutic value of certain biological preparations if loss in lactone structure of dehydroascorbic acid has taken place. Its use for the laboratory evaluation of blood and possibly urine is warranted (*5*); other biological tissues must be assayed with caution in regard to oxidation products of ascorbic acid or other substances entering into the phenylhydrazine reaction.

TABLE 1

ASSAY VALUE OF SYNTHETIC ASCORBIC ACID
(Unbuffered in aqueous systems)
Water Bath Temperature 38° C.
Mg./100 ml.

Gas	Ascorbic acid (reductone)		Dehydroascorbic acid (by H_2S)		Total vitamin C content of fluid		Value obtained by dinitrophenylhydrazine		Final H-ion concentration pH	
Gas used	N_2	O_2	N_2	O_2	N_2	O_2	N_2	O_2	N_2	O_2
(Time)										
Initial	22.6	19.4	1.8	4.06	24.4	23.46	27.0	27.0	5.02	4.97
2 hours	12.8	0	4.4	7.0	17.2	7.0	26.0	23.0	5.05	5.05
4 hours	7.2	0	5.6	5.2	12.8	5.2	27.0	21.5	5.32	5.30
6 hours	5.2	0	6.8	7.0	12.0	7.0	26.0	20.0	5.50	5.50

H-ion concentration of glass distilled water = pH 6.22.
No extraordinary precautions were taken other than the meticulous cleansing of glassware throughout. However, catalytic oxidation and not autoxidation occurred, because at this hydrogen-ion concentration there should have been little or no change in ascorbic acid values when aerated with nitrogen (*1*).

References

1. BARRON, E. S. G., DEMEIO, R. H., and KLEMPERER, F. *J. biol. Chem.*, 1936, **112**, 625.
2. HIRST, E. L. *Fortschritte der Chemie Organischer Naturstoffe.* Wien, 1939.
3. PENNEY, J. R., and ZILVA, S. S. *Biochem. J.*, 1943, **37**, 39.
4. PENROSE, L., and QUASTEL, J. H. *Biochem. J.*, 1937, **31**, 266.
5. PIJOAN, M., CATCHPOLE, H. R., and HAUGEN, G. Naval Medical Research Institute report to the Bureau of Medicine and Surgery, U. S. Navy, 1944, X–333, No. 1 (open).
6. ROE, J., and KUETHER, C. A. *J. biol. Chem.*, 1943, **147**, 399.
7. SEALOCK, R. R., and SILBERSTEIN, H. E. *J. biol. Chem.*, 1940, **135**, 251.

News and Notes

Dr. Margery C. Carlson, assistant professor of botany at Northwestern University, has been granted leave for three months to undertake an expedition collecting plants in the region of Ahuachapán, El Salvador, close to the Guatemalan border. The expedition is a joint research project sponsored by the Chicago Natural History Museum and Northwestern University. Mr. Paul C. Standley of the Museum suggested this area for study because of its accessibility and because its floristics are practically unknown. The plants collected will fill an important gap in our knowledge of the flora of Central America. Special attention will be paid to the flowering plants of the region. In addition, effort will be made to get representative samples of algae, fungi, and certain forms of beetles. Dr. Carlson was accompanied by Miss Kate Staley, who will assist her in the field work. Guides and native helpers will be secured locally. This expedition is of considerable interest, not only because the territory is practically unexplored botanically, but also because Dr. Carlson is perhaps the first woman to lead a natural scientific expedition to El Salvador.

Dr. C. G. Brennecke, head of the Electrical Engineering Department, North Carolina State College, delivered a lecture on 10 January before the Sigma Xi Chapter of North Carolina State College. Dr. Brennecke spoke on "Atomic Energy."

Announcements

The Associated Press carried a dispatch from Canberra on 28 December 1945 declaring that "Australian scientists" had announced a new drug, paludrine, "which rendered malaria no more harmful than a common cold."

Richardson, Bellows, Henry and Company, Inc., personnel research analysts and consultants, have opened offices at 56 Beaver Street, New York 4, New York. The company will engage in the construction of aptitude, technical knowledge, interest, and personality tests, the development of directed interviewing methods and merit rating procedures, and the conduct of employee attitude and market surveys. Lt. Col. Marion W. Richardson, chairman of the Board of Directors, has served during the war as chief of Personnel Research, The Adjutant General's Office, War Department. Drs. Robert J. Wherry, Edward E. Cureton, Roger M. Bellows, Harold A. Edgerton, Douglas H. Fryer, Edwin R. Henry, Paul Horst, Herman H. Remmers, Robert C. Rogers, and Carroll L. Shartle are also associated with the company in various capacities.

Tuskegee Institute has received a grant of $5,400 from Swift and Company for research in animal nutrition. The grant covers a period of two years, and the specific problem is concerned with the "Mung Bean and Other Special Proteins for Poultry Feeding." The research will be directed by Dr. W. E. Belton, associate professor and head of the Department of Chemistry, with the assistance of Mr. E. J. Jefferson, assistant professor of poultry husbandry. The grant includes stipends for two graduate research assistants, one in chemistry and one in poultry husbandry. Dr. Belton and Mr. Jefferson are members of the staff of the George Washington Carver Foundation, a research organization of Tuskegee Institute founded by Dr. Carver in 1940 with an initial gift of $60,000. The research program of the Carver Foundation is concerned largely with the utilization of agricultural resources, with both practical and fundamental emphasis. In addition to research on problems which have developed through its own interests, the Carver Foundation also conducts a limited amount of research for private industry on a commercial basis, which serves as a source of needed income as well as to provide industrial experience for graduate students majoring in industrial chemistry.

Michigan State College has announced a gift of $15,600 from Swift and Company, Chicago, for a two-year study of the microscopic anatomy of fowl, which will be carried on by the College in cooperation with the U. S. Regional Poultry Research Laboratory.

The Governing Board of the Pan American Union, at its regular monthly session for January, requested the Government of the United States to convoke a Conservation Congress here in June 1947 to consider the problem of the protection and better utilization of this hemisphere's renewable resources.

This action, which was unanimously recommended by the Third Inter-American Agricultural Conference in Caracas, Venezuela, last July, is the result of studies carried on through facilities of the Pan American Union in a number of Latin-American countries and the United States during the past two and a half years. Prepared under the direction of Mr. William Vogt, chief of the Conservation Section, Division of Agricultural Cooperation of the Pan American Union, these studies have revealed such an alarming downward trend in the natural resources of the hemisphere that the conference is projected for the purpose of assembling and coordinating information on natural resources, and the initiation of conservation programs.

Latin America, according to Mr. Vogt, is far from being the rich storehouse of untapped natural resources that many people consider it to be. Vast areas have been deforested, and the destruction of forests is increasing at an accelerated rate. Overgrazing, through the maintenance of excessively large herds of cattle, sheep, and especially goats, is very general. With the destruction of vegetation, soil erosion has become the number one problem in most Latin-American countries. Rivers are silting in some cases, it is believed, at a faster rate than the Mississippi; and floods, resulting from upstream misuse of the land, are becoming increasingly dangerous. Wild life, potentially a very important resource in Latin America, is being exterminated through widespread destruction of habitat and, in many countries, through uncontrolled hunting.

"The Latin American problem," Mr. Vogt stated, "of course parallels the problem in the U. S. It is less serious in North America, however, for two reasons. The first is that public opinion has been sufficiently aroused so that we spend in the neighborhood of $1,000,000,000 a year on conservation, whereas Latin America, with approximately the same population, does not spend 5 per cent of this amount.

"The second advantage possessed by the United States is that it has far greater riches and is a much easier country to live with. Aside from the Argentine pampa, Latin America has no land comparable to our

Middle West. Most of the territory occupied by human beings in Latin America is hilly and subject to such heavy rainfalls that agriculture requires far more advanced practices than have been adopted by Latin American rural populations, or than are likely to be within many years."

The conference will be devoted primarily to field studies of land-use problems, such as sustained-yield forestry, grazing-land administration, national parks, watershed organization and water conservation, wildlife management and soil conservation districts, and perhaps marine and stream fisheries management and research.

"The American Republics," he adds, "are living on their capital and, unless there is a radical change in land management, they will become bankrupt. Within a hundred years, Mexico, for example, will have been largely destroyed. In some of the smaller countries, the situation is probably more serious. The person who knows how to read the land in relation to human occupancy cannot escape the conclusion that in many of our neighboring republics, living standards are steadily falling because of waste of natural resources. The problem is made even more critical by the fact that population trends are, in general, rising."

Dr. William H. Cole, director, Rutgers University Research Council, reports that Rutgers University, nine pharmaceutical manufacturers, and the Army Quartermaster Corps are pooling their knowledge and resources in an extensive cooperative research program which is making basic scientific studies of the properties and therapeutic values of protein hydrolysates and amino acids. When the work started in the Fall of 1943, the Bureau of Biological Research at Rutgers was cooperating with one industrial laboratory and only the equivalent of 5.5 full-time persons and 4 consultants were engaged in the project. Now nine laboratories and the Quartermaster Corps are cooperating in the study, and 24 persons, including 12 full-time investigators and 7 consultants, are participating in the research effort. Studies on the use of proteins, protein hydrolysates, and amino acid mixtures in normal and hypoproteinemic dogs were started to answer basic questions for a better understanding of protein metabolism—questions which must be answered if the use of convalescence is to have a sound basis. It was agreed at the start of the work that the team approach to the problems would be used and that all plans and results would be freely discussed at regular conferences of the Bureau staff and representatives of the cooperating organizations. In addition to frequent conferences for those participating in the project, two larger meetings were held during 1944–1945 so that other persons interested in the work could sit in on the discussions. Mimeographed reports of the proceedings were distributed to those who attended and to others who requested the information.

For the year beginning 1 October 1945, ten groups are cooperating in the project. Rutgers University through its University Research Council is contributing $32,610 and the laboratories $39,000 for the support of the work. The cooperating groups are: Sharp and Dohme Company; Swift and Company; E. R. Squibb and Sons; Arlington Chemical Company; Calco Chemical Company; Inter-Chemical Corporation; Abbott Laboratories; Merck and Company; Eli Lilly and Company; and the Quartermaster Corps of the U. S. Army.

A one-story, fireproof building of about 8,000 square feet of floor space is being planned to house the work and will be built when labor and material conditions permit. It will contain the most modern equipment and facilities for studies of dogs, rabbits, and rats. About one-third of the building will be air-conditioned.

Several scientific reports on the project already have appeared, and others are in preparation. Inquiries concerning the work should be addressed to Dr. James B. Allison, Rutgers University, New Brunswick, New Jersey. Dr. Allison, professor of biochemistry and physiology, is director and coordinator of the program.

Meetings

The Metropolitan Microchemical Society is sponsoring a symposium on microchemistry for the purpose of stimulating interest in this field. The symposium will be held on 1–2 March in Room 319, Roosevelt Memorial Building, American Museum of Natural History, New York City. The program follows:

Friday evening—"Welcome": L. K. Yanowski, Department of Chemistry, Fordham University; "Introduction": Al Steyermark, Microchemical Department, Hoffmann-La Roche, Inc., Nutley, New Jersey; "Weighing on a Micro Scale": L. T. Hallett, General Aniline and Film Corporation, Easton, Pennsylvania; "Microgram Methods": A. A. Benedetti-Pichler, Queens College. *Saturday morning*—"Volumetric Determinations": A. Sobel, Brooklyn Jewish Hospital; "Discussion of the Van Slyke Manometric Blood Gas Apparatus and Its Applications": D. D. Van Slyke, Hospital of the Rockefeller Institute for Medical Research, New York; "Mass Spectrometer": D. Rittenberg, College of Physicians and Surgeons, New York; "Photometric and Spectrophotometric Analysis": D. L. Drabkin, University of Pennsylvania.

Letters to the Editor

Federal Scientific Research

Under the title given above, R. G. Roberts and H. H. Beard (*Science*, 1945, **102**, 660) object to a proposal which they attribute to the "Board of Governors of Yale University." There is no such body. Reference to the article cited (*Science*, 1945, **102**, 524–525) reveals that the group in question is the Board of Permanent Officers of the Sheffield Scientific School—in other words, the full professors in the Division of Science of the Graduate School, Yale University.

CHESTER R. LONGWELL

Yale University

One World, Yet Different Biologies?

Although in his work, *One world*, the late Wendell Willkie wrote a good bit without saying anything, the concept implied in the title is currently attracting favorable attention, even among political leaders. Of all groups, one might have expected that scientists would be most insistent that there is but a single sort of their particular branch of endeavor—one biology, one chemistry, one physics, and so on.

Accordingly, it has been rather disconcerting to find successive articles appearing in recent issues of *Science* under the title "Soviet Biology." For, the use of a modifying term in this manner implies that there is some other kind of biology which is different and, presumably, inferior—perhaps racial, e.g. Polynesian Biology; or religious, as Baha'i Biology; or even, dare we say it, Capitalist Biology.

Mr. Editor, when further articles of this sort reach your desk, would it be too much to ask that you alter the title so that no racial, religious, or political term is permitted to modify the word science, or any branch thereof? If an article is headed "Shangri-La Biology," could it not be changed to "Biology in Shangri-La"?

EDGAR T. WHERRY

Department of Botany, University of Pennsylvania

The Abstracting of Biological Films

The section on visual instruction in *Biological Abstracts* provides a useful service to prospective film users. However, its usefulness would be greatly increased if the coverage could be extended to all biological films. At the present time the section is limited to the fields of microbiology, immunology, and public health, which are reviewed by a committee of the Society of American Bacteriologists headed by Dr. H. E. Morton. Correspondence with the editorial office of *Biological Abstracts* indicates that they are very willing to publish abstracts of all biological films that can be located. Other societies have committees on visual instruction, but they have not been set up to furnish such abstracts. In some cases these committees list approved films for the benefit of the members of their societies. Other films do not appear on the approved lists because of errors or misconceptions within the films. However, the work of such committees would be much more useful if all of this information were made generally available in abstract form to a larger group of film users.

The present abstracts furnish precisely the information that a prospective user needs. By giving the shortcomings and limitations of a film the user can frequently adapt it to his purposes. Although useful information may be obtained from the *Educational Film Guide* published by H. W. Wilson Company, this publication does not ordinarily reach the desk of the biologist, and the information supplied is not complete. Adequate coverage of all biological films in *Biological Abstracts* would serve to keep the biologist abreast of this expanding field. It is to be hoped that the other biological societies may soon constitute their committees on visual instruction that a program for abstracting all films of interest to the biologist may ultimately be worked out.

W. MALCOLM REID

Monmouth College, Illinois

Glutamine From Rye Grass

Greenhill and Chibnall (*Biochem. J.*, 1934, 28, 1422–1427) and Curtis (*Plant Physiol.*, 1944, **19**, 1–5) noted marked exudation of glutamine on grass fertilized in the spring with nutrients high in ammonia. Greenhill and Chibnall did not get similar results later in the season, and Curtis was unable to reproduce the phenomenon.

In the tomato (G. J. Raleigh. *Plant Physiol.* In press) marked guttation followed the addition of either nitrate or of ammonium salts to solutions deficient in nitrogen. With the thought that a period of growth with low available nitrogen and consequent high carbohydrate reserves might be a prerequisite for glutamine exudation, domestic rye grass was seeded 25 September 1944, in flats with hardware cloth bottoms containing 1½ inches of potting soil. The flats were kept in the greenhouse until 28 October when they were moved out-of-doors to a sheltered area. In order to facilitate leaching, they were placed on cinders approximately 8 inches deep.

By 28 March the rye grass had made good growth but was light in color, indicating nitrogen deficiency. From that date to 26 June a total of 52 flats were fertilized with ammonium chloride dissolved in water at the rate of 300 pounds of the dry salt to the acre at 8 different times during that period. In most cases, the grass was clipped before the applications of fertilizer. The NH_4Cl was applied in mid-afternoon on days when the weather prediction indicated a clear, cool night.

Without exception, usually on the first or second day following fertilization, nitrogen-deficient grass produced quantities of exudate sufficient to make it possible to collect it, by clipping and drying the grass, rubbing it

htly, and collecting the dry exudate thus dislodged. ne lot so collected was dissolved in water so as to float d settle off the particles of grass and part of the solu- on treated for two hours at 100° C. at pH 6.5 in ac- rdance with the methods of Vickery, *et al.* (*Biochem.* , 1935, 29, 2710–2720). A marked increase in ammonia llowing the treatment indicated the presence of glu- mine. A total of 12 flats fertilized at three different mes while the grass was making rapid growth of dark een color following earlier applications of NH_4Cl pro- ced relatively little or no white exudate.

G. J. RALEIGH

rnell University

aptain Jenkins' Views

The objections of Captain John G. Jenkins, USNR, to e universal application of statistical methods to re- arch in psychology probably are well taken. Indeed, ese objections may well be extended to many fields of ientific endeavor and to many methods of research. ny circumscribed test assumes that certain ideal condi- ons shall be fulfilled, but in reality the ideal is seldom resent or even achievable. Therefore, any single test re- eals only one aspect of the situation. Usually the situ- tion is far more complex than we imagine.

The chief injury of the standardized test arises not rom its limited nature, but from the mental attitude of nvestigators that all research must be fitted to some par- icular test. However, all tests are only tools and like achine tools they are useful in some, but not in all, situ- tions. Years ago Fabre pointed out this discrepancy etween the ideal tool and the actual situation. Although he inimitable observer failed to appreciate the marvelous daptability of Darwin's theory, his words from "A dig t the evolutionists," translated by Alexander Theixeira De Mattos, are applicable to the present situation:

"But to this calculus, all-powerful so long as it does ot leave the domain of the ideal, let us submit a very odest reality: the fall of a grain of sand, the pendular ovement of a hanging body. The machine no longer orks, or does so only by suppressing almost everything hat is real. It must have an ideal material point, an deal rigid thread, an ideal point of suspension; and then he pendular movement is translated by a formula. But he problem defies all the artifices of analysis if the oscil- ating body is a real body, endowed with volume and fric- ion, if the suspensory thread is a real thread, endowed ith weight and flexibility; if the point of support is a eal point, endowed with resistance and capable of deflec- ion. So with other problems, however simple. The exact eality escapes the formula."

PAUL D. HARWOOD

shland, Ohio

. . . I think *Science* is to be complimented on Captain John G. Jenkins' article (*Science*, 1946, 103, 33–38). The general indictment against the technical man, and it is not without some basis, is that his scientific approaches and thought patterns are devoted to obscure fields without any realization of practical value. While the scientific purity of thought is highly commendable it would appear that some of the effort in that direction would have greater significance if interpreted in the light of some of Captain Jenkins' remarks.

E. C. KOERPER, *In Charge of Special Engineering*
A. O. Smith Corporation, Milwaukee, Wisconsin

Pancreatic Enzymes and Liver Fat

The late Dr. A. H. Palmer was well known for his work on the proteins of milk whey. He joined this department in September 1944 and undertook at my suggestion the separation and identification of enzymes present in the antifatty liver fraction of pancreas, prepared by the method of Entenman and Chaikoff (*J. biol. Chem.*, 1941, 138, 477). Palmer's work was hampered by ill health and terminated by his death on 10 April 1945. During his short period of application to his new problem, however, he obtained in crystalline form and in fair yield trypsinogen and chymotrypsin from the pancreas extract. He identified these two enzymes to his own complete satisfaction and believed that at least one more proteolytic ferment was present in the extract.

Chaikoff, Entenman, and Montgomery (*J. biol. Chem.*, 1945, 160, 489) state that their findings are consistent with the concept that the antifatty liver factor (of pancreas) is enzymatic in nature. The results of Palmer's work provided evidence in support of this view, and it is most regrettable that his notes are not sufficiently complete to enable us to make a detailed report of his findings. Some of his preparations are still available, however, and it may be possible to complete certain aspects of his work.

The probability that the enzymes contained in the pancreas which is fed to depancreatized dogs contribute very significantly to the total lipotropic effect by releasing lipotropic factors from the various constituents of the diet has been emphasized in previous reports from Chaikoff's and this laboratory. The possibility that these enzymes played a role in the prevention of fatty livers in insulin-treated depancreatized dogs was, of course, mentioned and seriously considered by Prof. J. J. R. Macleod and his collaborators in the original work in this field.

C. H. BEST

Banting and Best Department of Medical Research
University of Toronto

Absorption of Phenol Vapors by Plants

An interesting phenomenon concerned with the absorption of phenol-like vapors by plants was observed during the Summer of 1945 in and about Ambler, Pennsylvania. A factory located on the outskirts of Ambler started the commercial production of 2,4-dichlorophenoxy acetic acid (2,4-D). This product has been used as a plant growth regulator and has been developed by the Bureau of Plant Industry, Soils and Agricultural Engineering, as a weed killer.

In the production or purification of the product at

Ambler, phenolic vapors escaped into the atmosphere and were distributed over several square miles of the area surrounding the factory. The concentration of the vapors varied with the atmospheric conditions: on clear days the concentration was slight or not noticeable; on cloudy days with low atmospheric ceilings the vapors were quite noticeable at distances of one to two miles from the factory. The summer in this vicinity was a wet one, the number of cloudy days and nights being above average.

One determination of the concentration of the vapor taken by the Pennsylvania Department of Health at the source is reported equivalent to parts of dichlorophenol at 4 p.p.m. However, at this concentration near the source, the odor is quite noticeable. While the vapors may be objectionable, they have not yet been regarded as a human health hazard, the factory workers having been exposed to these concentrations without any reported ill effects.

On the other hand, the flavors of certain garden vegetable crops grown within the area were affected by the vapors. Tomatoes were especially affected, with string beans, Swiss chard, and lettuce responding in lesser degree. Carrots, beets, potatoes, peppers, and cabbages were apparently not affected.

Samples of vegetables were secured by the writer from gardens located approximately 200, 400, and 600 yards and one mile and one and one-half miles from the factory.

The tomato fruits acquired a pronounced "medicine" flavor of phenolic type, yet not unlike that of iodoform, although iodine is not involved in the compound. The concentration of the unusual flavor in the various fruits was inversely proportional to the distance of location of the gardens from the factory. However, wind drift affected the concentration from time to time over the area.

The tomato deposited the flavor in the fruit at all stages of maturity and retained it permanently or until it decayed. Young, quite immature fruit possessed the flavor, which could easily be detected by odor when the fruit was cut or broken open. As the fruit matured on the vine the concentration apparently increased until the fruit was picked. Tomatoes grown at a distance of one or one and one-half miles from the factory, and, where it is believed the concentration of the vapors in the air was usually less than in gardens nearer to the factory, varied in the deposition of phenolic flavor in the several lobes or segments. Whereas one lobe was nearly free of the flavor, another one was quite strong. Fruit produced nearer to the source of the vapors acquired a more uniform deposition. The concentration of the phenolic flavor apparently did not decrease in storage. Contaminated fruits stored for 14 days five miles from Ambler in a normal atmosphere possessed as strong a flavor as when they were picked, as determined by taste tests. Fruits picked green and allowed to ripen in a normal atmosphere for 14 to 21 days seemingly had not lost any of the u usual flavor. Ripe fruits retained the flavor in norm air or refrigerator temperatures. Stewing the ripe fru intensified the flavor. All fruits were carefully wash and peeled, and in no case was there any noticeable flav in the skin.

No chemical determination as to character or amou was made of the deposited flavor. Three tolerance te were made by the writer on three different days, sampl being secured from gardens located about one mile fro the factory. Twelve ounces of well-colored, ripe fru that was carefully washed were eaten. Nausea follow within 15 minutes and continued for two to three hou On alternate days the same experiment was made with a equal weight of ripe tomatoes grown in a normal atmo phere five miles from Ambler. No ill effects we noticed.

String beans grown in the same gardens as were so of the tomatoes also developed off-flavors which were n as strong of phenols as those of the tomatoes. The bean however, were unpalatable, and several gardeners r ported that they had to dispose of their canned crops, persons eating them were nauseated.

Swiss chard developed a very strong, unpalatable tast Eating a small quantity induced slight nausea. Lettu grown within one-quarter of a mile of the source h developed a strong, unnatural off-flavor differing fro that of "bitter" lettuce.

Samples of tomatoes were secured from several oth localities within the Philadelphia metropolitan area whe large chemical establishments have "zones of influence" and fields and gardens are subjected to vapors of var ous sorts. In none of the samples secured from the areas was there noticed any unnatural flavor. Howeve so far as is known, none of these latter factories evol phenolic-like vapors.

It was not determined whether the vapors were a sorbed directly through the leaves or by the roots fro accumulations in the soil that may have been collecte by the rains and dews.

The abnormal effects were noticed only on the flavo of the fruit or leaves as described above. In no case wa there observed any structural deformation on any plant due to the vapors, although 2,4-D and other compound of the hormone group have the ability to markedly affe plant structure when sprayed on certain plants in ver weak concentrations.

It is believed important to call attention to the hazard involved in rendering important crop-producing areas us less by the dissemination of certain industrial vapors eve in light concentrations. Following the experience aroun Ambler in 1945 the factory officials are reported to b active in altering their process so as to prevent an further escape of dangerous vapors.

E. G. Beinhart

Wyndmoor, Pennsylvania

OPTICAL GLASS

FOR THE EYES OF SCIENCE

The optical equipment upon which science is so dependent is, in turn, dependent upon optical glass. Prior to World War I, American-made optical glass was a laboratory curiosity. At that time Bausch & Lomb was able to perfect the methods and formulae with which it had been experimenting for several years . . . producing the first commercial quantities of fine optical glass ever made in this country. Since then, optical glass making at Bausch & Lomb has been continuously expanded until today Bausch & Lomb produces the major portion of the optical glass used in this country . . . each of the many types for its specific optical use. Bausch & Lomb Optical Company, Rochester 2, N. Y.

Illustrated is the largest single usable piece of optical glass ever made in America. Weighing some 379 pounds, after two months of shaping and annealing, it will be ground as a 4° prism for use in the world's largest Schmidt-type telescope, to be erected at Puebla, Mexico.

BAUSCH & LOMB

ESTABLISHED 1853

Book Reviews

Industrial oil and fat products. Alton E. Bailey. New York: Interscience Publishers, 1945. Pp. x + 735. (Illustrated.) $10.00.

This volume is an important addition to the literature on oil and fat technology. It brings up to date the description of commercial processes by which both edible and nonedible products of importance are manufactured from fats and oils.

Following a brief section dealing with the composition, reactions, and properties of fats there is a more extensive treatment of the raw materials commonly used commercially, the specific products such as salad oils, shortenings and margarine, soaps and other surface active materials, paints and varnishes, and a group of miscellaneous products. More than one-third of the book is given over to a detailed examination of processes used in the fat and oil industry, including extraction, refining and bleaching, deodorization, hydrogenation, soap working, and polymerization.

Throughout the book the author has used graphs, tables, and formulas to good advantage in presenting and illustrating the text. The end result is that the book is greatly superior as a reference work to any of the publications in this field. The author has gone a long way indeed toward narrowing the gap between existing but scattered knowledge and orderly, readable, and useful assembly for publication. His own long and distinguished association with the field has provided a sound background for the endeavor.

HERBERT E. LONGENECKER

University of Pittsburgh

Vitamins and hormones: advances in research and application. (Vol. III.) Robert S. Harris and Kenneth V. Thimann (Eds.). New York: Academic Press, 1945. Pp. xv + 420. (Illustrated.) $6.50.

This volume presents another valuable group of review papers on vitamins and hormones. The reviews are especially valuable because the authors of each chapter are actively engaged in research dealing with the subject concerned. The nine chapters are divided between five chapters dealing definitely with vitamins, three with hormones, and one with the antipernicious anemia substances of liver, which can probably be closely associated with the field of vitamins. Individual chapters differ greatly in length and completeness. The longest and most extensive paper, written by Knight, is on "Growth factors in microbiology," and the shortest, by Dodds, is on "Possibilities in the realm of synthetic estrogens" and deals mainly with the work which led to the recognition of three new synthetic estrogens.

The editors comment in the Preface that the subject matter in the earlier volumes was somewhat unrelated and that more effort to integrate the papers would be made in the future. This integration is already evident in this volume, since the first three chapters deal with very closely related subjects, namely, interrelation vitamins, synthesis of B vitamins by intestinal bacte and sulfonamides, and vitamin deficiencies. In fa there is a little repetition in the subject matter present in these three chapters, but footnotes are added to cor late the related material. The chapter on the chemist of antipernicious anemia substances of liver logically f lows the chapter in Volume I on the physiological a clinical aspects of pernicious anemia and covers ve completely the chemical work on the pernicious anem factor or factors which has been done during the p seventeen years.

The chapter dealing with manifestations of prenat nutritional deficiency is especially timely and shou stimulate further nutritional work with animals beyo the period of rapid growth. Although the chapter "Growth factors in microbiology" is most extensive, is interesting to note that little, if any, material on t newer factors, even folic acid, is included. The long chapters on hormones deal with the action and metab lism of gonadotropic hormones and the role of acety choline in the mechanism of nerve activity.

It is interesting to note the interpretations which t reviewers have given to original work. Naturally, o should expect some differences of opinion, but in a review care should be taken to quote correctly from t original papers. It appears that at least one such err has been made in this volume. On page 8 the work Griffith and Mulford is referred to, and it is stated th they claim that niacin alleviates the severity of the symp toms of choline deficiency in rats. Actually, the auth state that nicotinic acid exerts a moderate choline-oppo ing action.

C. A. ELVEHJE

University of Wisconsin

Advances in protein chemistry. (Vol. II.) M. L. Ansc and John T. Edsall (Eds.). New York: Academic Pres 1945. Pp. xiv + 443. $6.50.

A knowledge of protein chemistry is basic to an under standing of many problems in biochemistry, immunology and pathology, and is equally indispensable to the contr and development of new techniques in certain aspects o the industrial arts. A large and diversified literature o the proteins has accumulated in journals all over th world, and presumably still more data are awaiting thei turn to emerge from the archives of the late war effor Short of turning librarian, it is nearly impossible for th active investigator to keep abreast of this ever-expandin literature. The need for competent reviews on variou significant aspects of the proteins has become patent, and the present series on *Advances in protein chemistry* min isters to this need admirably. The editors have exercised a fine discrimination and have achieved a good balance among topics of fundamental and applied interest both in the earlier and in the present volume.

In the present volume there are four reviews on fundaental studies on protein structure or reactivity. "The actions of Formaldehyde with Amino Acids and Proins," by French and Edsall, and the consideration of X-Ray Diffraction and Protein Structure," by Fanchen, are masterly presentations of the respective subts. The success of the former authors in condensing d making clear and readable the vast literature on rmaldehyde-protein reactions is noteworthy. The table embled by Fankuchen on X-ray data on the crystalline oteins is a valuable aid to the reader. In a review on Protein Denaturation and the Properties of Protein oups," Anson has made a thoughtful and straightforrd presentation of his views on this topic. A discusn on "Terminal Amino Acids in Peptides and Proins," by Fox, describes some of the methods which ght be employed in determining amino acid sequences proteins.

There are two excellent reviews on tissue proteins, one Dawson and Mallette on "Copper Proteins," and the her by Karl Meyer on "Mucoids and Glycoproteins." e former covers the topics of the hemocyanins, the oxises, and metalloproteins generally; the latter is conrned with those polysaccharides and smaller sugars ich are attached to a number of proteins. Both reews should be immensely valuable to workers in many lds.

Two reviews on foodstuffs, "Amino Acid Composition Food Proteins," by Block, and "Wheat Gluten," by lish, are interesting contributions to this subject, the bles in both reviews being of particular usefulness to rkers in nutrition. The range of problems encountered cereal technology may be a surprise to those accusmed to the ready availability of bread nicely wrapped wax paper on the grocer's shelves.

There are two reviews on methods of protein analysis. ne, by Snell, on the "Microbiological Assay of Amino cids" is very well done and of considerable contemorary interest. The other, by Martin and Synge, covers early all methods of analysis of hydrolyzed proteins exept the microbiological; close to 800 references are cited 63 pages of text, and the thought arises that perhaps o much has been attempted in too small a space.

A contribution of interest to medicine is a review by aul Cannon on "Antibody Production and Resistance Infection," which is largely concerned with the relaion of protein metabolism to resistance mechanisms in e animal body.

JESSE P. GREENSTEIN
ational Cancer Institute, Bethesda, Maryland

canning Science—

The first number of the anthropological series pubshed by the Field Columbian Museum, Chicago, is e "Archaeological Studies among the Ancient Cities f Mexico," by the curator, William H. Holmes. The rst part, which alone has appeared, is devoted to the rchitectural remains of Yucatan.

—21 February 1896

Scientific Book Register

BAMANN, EUGEN, and MYRBÄCK, KARL. *Die Methoden der Fermentforschung.* New York: Academic Press, 1945. Vol. I: pp. xx + 1162; Vol. II: pp. 1164–2108; Vol. III: pp. 2110–3047; Vol. IV: pp. 3049–3388. (Illustrated.) $65.00.

FREEDMAN, SAMUEL. *Two-way radio.* Chicago-New York: Ziff-Davis, 1946. Pp. xxii + 506. (Illustrated.) $5.00.

JOHNSON, MAXWELL O. *Correlation of cycles in weather, solar activity, geomagnetic values, and planetary configurations.* (1st ed.) San Francisco: Phillips and Van Orden, 1946. Pp. xiii + 149. (Illustrated.)

KRAFFT, CARL FREDERICK. *Ether and matter.* Richmond: Dietz Printing Co., 1945. Pp. viii + 117. (Illustrated.)

LEFFINGWELL, GEORGIA, and LESSER, MILTON A. *Glycerin: its industrial and commercial applications.* Brooklyn: Chemical Publishing Co., 1945. Pp. 268. (Illustrated.) $5.00.

MACY, ICIE G. *Nutrition and chemical growth in childhood: original data.* (Vol. II.) Springfield, Ill.: Charles C. Thomas, 1946. Pp. xxv–xlii + 433–1460. (Illustrated.) $10.00.

O'NEILL, JOHN J. *You—and the universe—what science reveals.* New York: Ives Washburn, 1946. Pp. vii + 328. $3.50.

SNEDECOR, GEORGE W. *Statistical methods: applied to experiments in agriculture and biology.* Ames, Ia.: Iowa State College Press, 1946. Pp. xvi + 485. $4.50.

STOKLEY, JAMES. *Electrons in action.* New York-London: McGraw-Hill, 1946. Pp. x + 320. (Illustrated.) $3.00.

WALLS, GORDON LYNN. *The vertebrate eye and its adaptive radiation.* Bloomfield Hills, Mich.: Cranbrook Institute of Science, August 1942. (Bull. No. 19.) Pp. xiv + 785. (Illustrated.) $6.50.

WEIDENREICH, FRANZ. *Giant early man from Java and South China.* (Vol. 40, Pt. 1, Anthropological Papers.) New York: American Museum of Natural History, 1945. Pp. 134. (Illustrated.)

WENDT, GERALD, *et al.* (Eds.) *The atomic age opens.* Cleveland: World Publishing Co., 1945. Pp. 251. (Illustrated.) $1.00.

WOLFE, JOHN H., *et al. Industrial algebra and trigonometry with geometrical applications.* New York: McGraw-Hill, 1945. Pp. 402. (Illustrated.) $2.20.

YOUNG, C. B. F., and COONS, K. W. *Surface active agents: theoretical aspects and applications.* Brooklyn: Chemical Publishing Co., 1945. Pp. x + 381. (Illustrated.) $6.00.

Catalogue Corner

Laboratory measuring instruments. A catalogue h just been issued by the DeJur-Amsco Corporation co ing its line of electrical indicating instruments, pot tiometers, rheostats, and photographic apparatus. T catalogue is well illustrated with cuts, graphs, and d grams that enable the reader to grasp the essent specifications at a glance. Research workers who u photography in their work will be interested in the n exposure meters and enlargers developed by the DeJ laboratories. *Catalogue SC–463.* DeJur-Amsco Corpo tion, Northern Boulevard at 45th Street, Long Isla City, N. Y.

Cathode-ray tube photography. The Eastman Kod Company is able to supply a brochure on Kodak ma rials for use in the photography of cathode-ray tub The contents as outlined are: types of cathode-r screens; recording by direct cathode-ray action; cam equipment and technique; criteria for the choice of p tographic materials; developing and fixing; formulas n chemicals; effective speeds of Kodak materials; and st number of Kodak recording materials. *Kodak materi for the photography of cathode-ray tubes. Brochure S 463.* The Eastman Kodak Company, Rochester 4, N.

Biological materials and supplies. The Carolina B logical Supply Company publishes a four-page fold each month in which it gives detailed information abo several of the many hundreds of items regularly carri in stock. *Carolina tips* is the title of the folder, wh may be obtained from the company. The 1945–46 ca logue of biological materials has also been receiv Several thousand items are listed, with descriptions a prices, and many illustrations are used. *Catalogue SC–463.* Carolina Biological Supply Company, Elon Co lege, N. C.

Tweezer spot welding machine. A recent announc ment by the Tweezer-Weld Corporation about its n portable welding unit should interest research men bo in industry and academic circles. Nearly every labor tory has constant need for a unit to make strong—a in many cases, extremely small—welds. This new u consists of electrodes fashioned in the shape of tweeze The leads are covered with a flexible plastic materi According to the specifications, it can be plugged in a 115-volt, 60-cycle power supply and can be adapte easily to 220 volts. *Tweezer spot welding machi Leaflet SC–463.* Tweezer-Weld Corporation, 280 Pla Street, Newark 2, N. J.

Spectrographic news. The Harry W. Dietert Compan issues a news letter describing the products being d veloped in its laboratories and those of its affiliate, th Applied Research Laboratories of Glendale, Californi *Spectrographer's news letter SC–463.* Harry W. Dieter Company, 9330 Roselawn Avenue, Detroit 4, Mich.